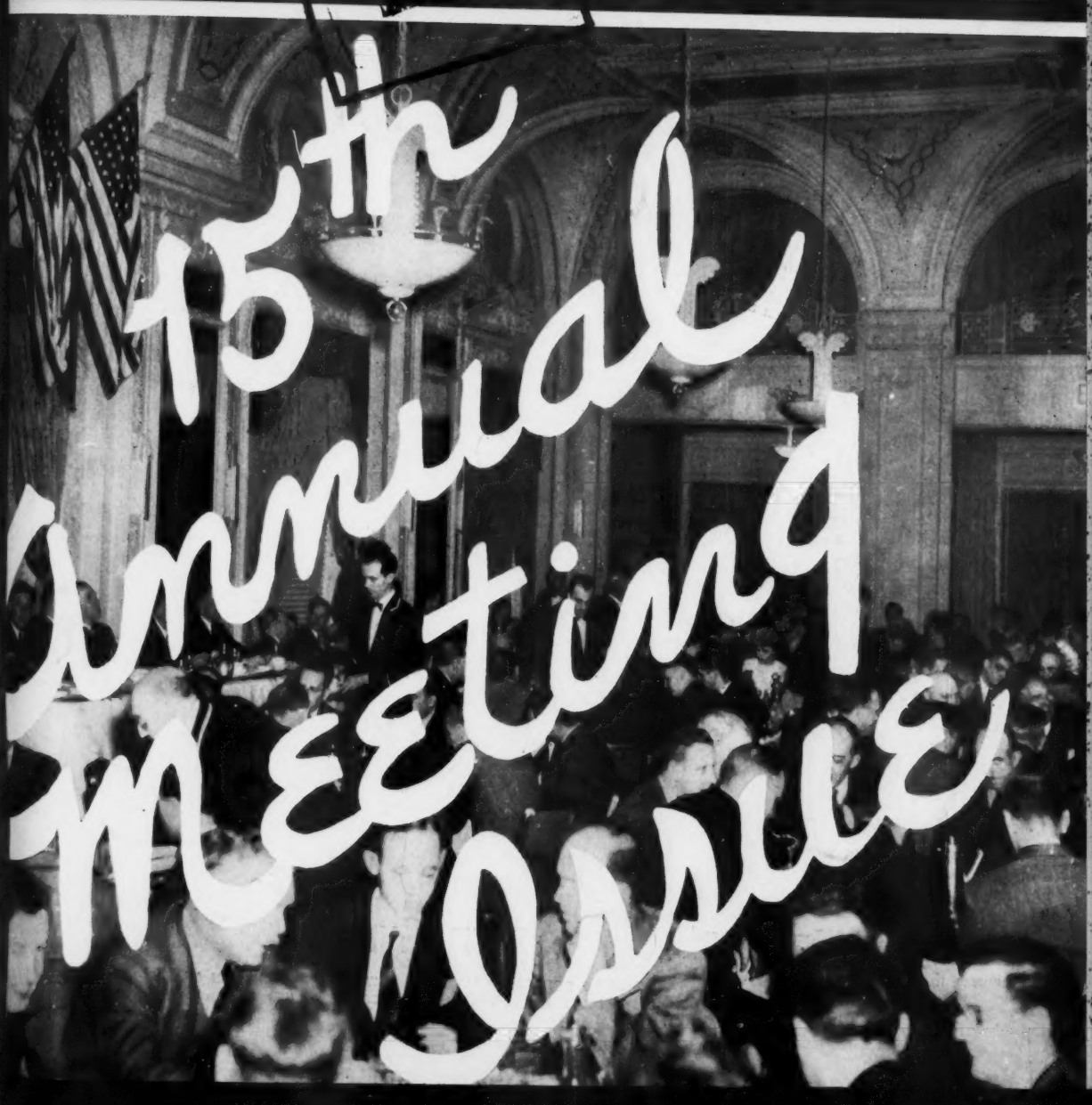
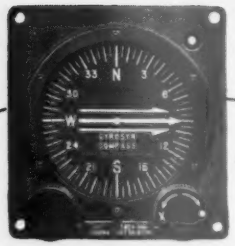
AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

MARCH 1947





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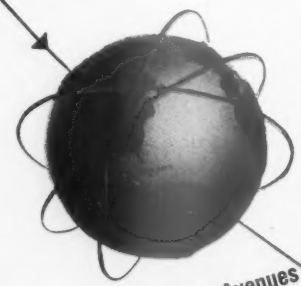

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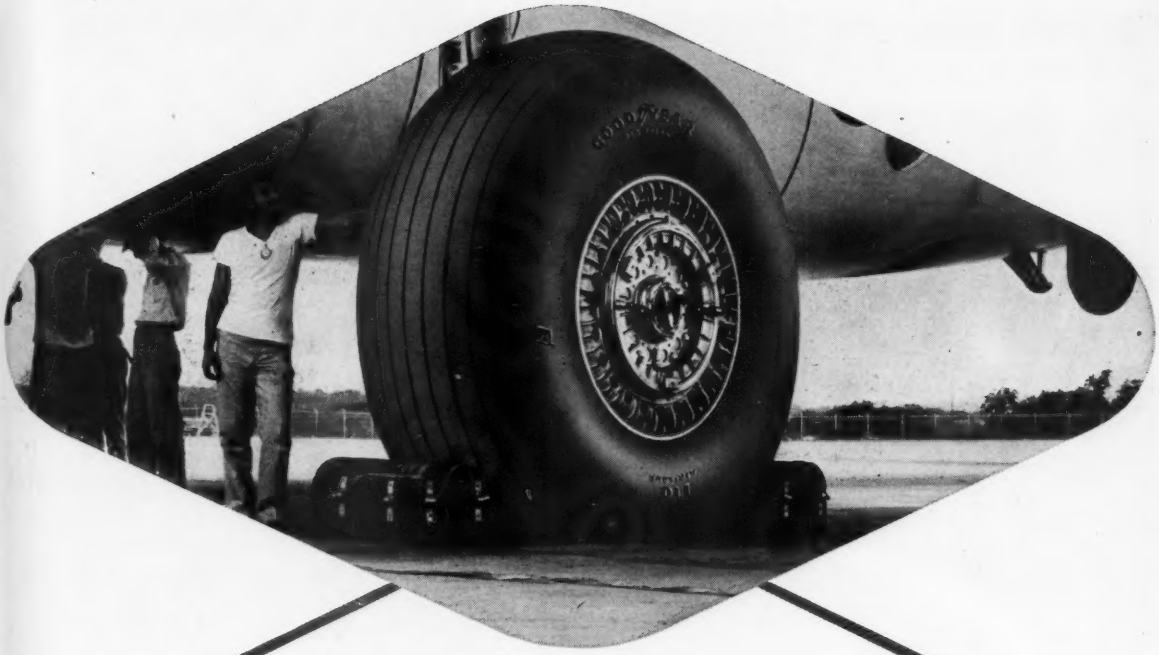

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Cover—Navy Day Luncheon, Hotel Astor, New York, January 29, 1947.

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AERONAUTICAL ENGINEERING REVIEW

Vol. 6 March, 1947 No. 3

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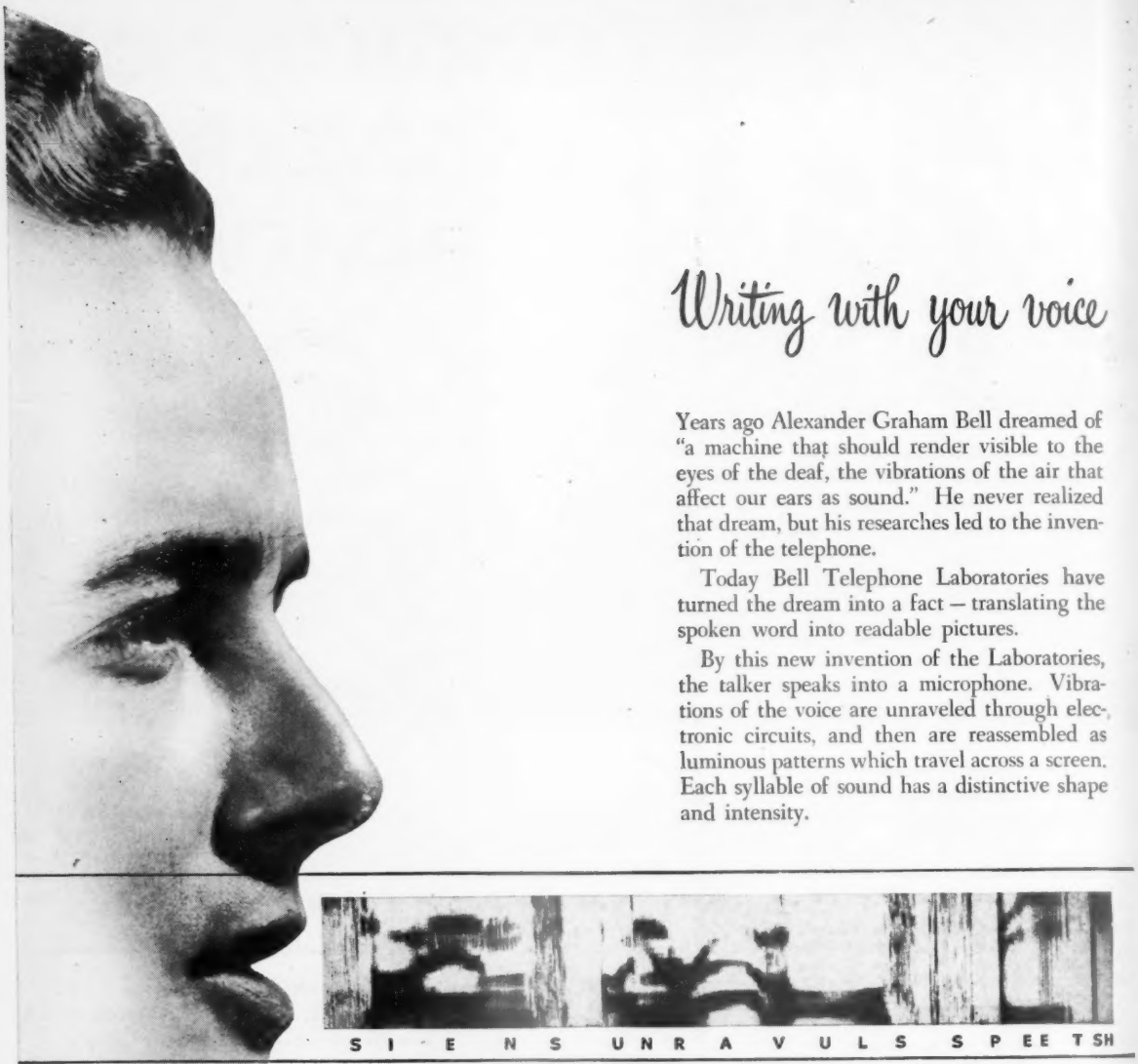

Science unravels speech

Writing with your voice

Years ago Alexander Graham Bell dreamed of "a machine that should render visible to the eyes of the deaf, the vibrations of the air that affect our ears as sound." He never realized that dream, but his researches led to the invention of the telephone.

Today Bell Telephone Laboratories have turned the dream into a fact – translating the spoken word into readable pictures.

By this new invention of the Laboratories, the talker speaks into a microphone. Vibrations of the voice are unraveled through electronic circuits, and then are reassembled as luminous patterns which travel across a screen. Each syllable of sound has a distinctive shape and intensity.

Visible speech is still in its infancy, and is not yet available to the public. But educators of the deaf are now evaluating it. Indications are that the deaf can learn to read the patterns and, by comparing the patterns their own voices make with the patterns of correct speech, can improve their diction.

Patterns of visible speech also provide a means for analyzing and recording sound in the study of phonetics and of languages. Eventually, visible speech may make possible visual telephony for the deaf.

This is but one of many contributions by Bell Telephone Laboratories to the understanding and control of sound.

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I.A.S. News

A Record of People and Events of Interest to Institute Members

Annual Business Meeting of the Institute

Reports of President, Director, and Treasurer

THE FIFTEENTH ANNUAL MEETING of the members of the Institute was held at the Hotel Astor, New York, January 29, 1947. Arthur E. Raymond, President of the Institute, presided.

Elmer A. Sperry, Jr., Teller, reported that he had received and counted 729 valid proxies for voting at the Annual Meeting—a quorum of the voting membership.

Charles H. Colvin, Chairman of the Nominating Committee, placed in nomination the following members for election to vacancies on the Council: Preston R. Bassett, Wellwood E. Beall, Rex B. Beisel, Luis de Florez, John K. Northrop, Arthur E. Raymond, and Burdette S. Wright, for a term of 1 year each; Victor E. Carbonara, C. C. Furnas, J. A. Herlihy, John C. Leslie, Ernest G. Stout, for a term of 3 years each; and the following area councilors for a term of 1 year each: Eastern Area—Carl de Ganahl, C. Fayette Taylor; Central Area—Willson H. Hunter, John C. Squiers; Western Area—A. Elliott Merrill, M. F. Stoughton. On motion duly made, seconded, and carried they were unanimously elected. The following were nominated and elected in like manner to serve on the Nominating Committee for 1947: Frank W. Caldwell, Charles H. Colvin, Hugh L. Dryden, Hall L. Hibbard, J. C. Hunsaker, Arthur E. Raymond, Elmer A. Sperry, Jr., Chairman, and Burdette S. Wright.

The Annual Reports of the President, Treasurer, and Director were read and approved. (See the following pages for the complete reports.)

The Secretary presented a list of honors conferred by the Institute in 1946 as follows: The Sylvanus Albert Reed Award to Robert T. Jones; The Thurman H. Bane Award to Col. Leighton I. Davis; The Robert M. Losey Award to Carl G. Rossby; The John Jeffries Award to Brig. Gen. Malcolm C. Grow; The Octave Chanute Award to Ernest A. Cutrell; and The Lawrence Sperry Award to Peter R. Murray.

Honorary Fellowship in the Institute to: Frank W. Caldwell, Director of Research, United Aircraft Corporation, and Sir Geoffrey de Havilland, de Havilland Aircraft Company, Ltd.

Fellowship in the Institute to: William G. Brown, Colonel, Office of Assistant Air Staff, A.A.F. Liaison with National Defense Research Committee; E. W. Conlon, Head of the Department of Aeronautical Engineering, University of Michigan; S. Paul Johnston, Director, Institute of the Aeronautical Sciences; Jerome Lederer, Chief Engineer, Aero Insurance Underwriters; A. E. Lombard, Engineering Consultant, Consolidated Vultee Aircraft Corporation; Russell G. Robinson, Assistant Director of Aeronautical Research, N.A.C.A.; Addison May Rothrock, Chief of Research, Cleveland Laboratory, N.A.C.A.; Francis R. Shanley, Division Engineer, Engineering Research, Lockheed Aircraft Corporation; Abe Silverstein, Chief, Wind Tunnel and Flight Division, Compressibility Unit, Cleveland Laboratory, N.A.C.A.; J. Parker Van Zandt, Aviation Director, The Brookings Institution.

Foreign Fellowships to: H. Roxbee Cox, Chairman and Managing Director, Power Jets Research and Development Ltd.; J. Laurence Pritchard, Secretary, The Royal Aeronautical Society.

Charles H. Colvin, Chairman of the Nominating Committee.

The Secretary announced that the Council had elected the following officers of the Institute for 1947: President, Preston R. Bassett; Vice-Presidents, Wellwood E. Beall, Rex B. Beisel, Luis de Florez, and John K. Northrop; Director, S. Paul Johnston; Executive Vice-President, Bennett H. Horchler; Treasurer, Burdette S. Wright; Secretary, Robert R. Dexter; and Controller, Joseph J. Maitan.

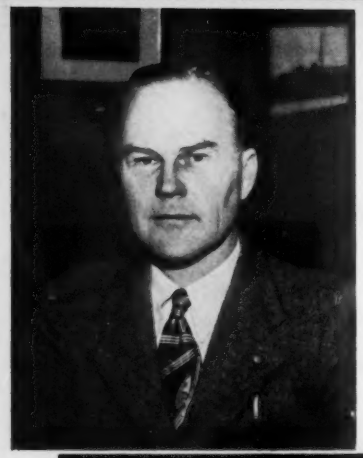
ROBERT R. DEXTER, *Secretary*

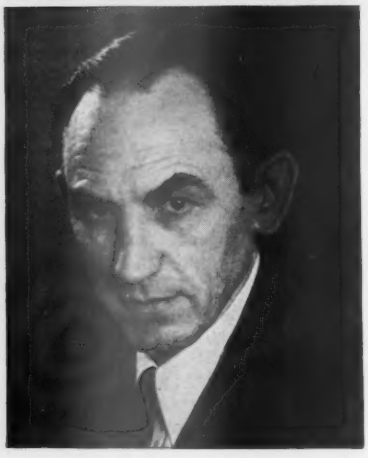
I.A.S. Calendar

March 28, 1947	Aircraft Propulsion Meeting, Cleveland, Ohio
May 26–27, 1947	Personal Aircraft Meeting, Detroit, Mich.
August 7–8, 1947	Annual Summer Meeting, Los Angeles, Calif.

For further details see page 19.

Institute Council for 1947





Victor E. Carbonara, General Manager, Kollsman Instrument Division, Square D Company.

William K. Ebel, Vice-President—Engineering, The Glenn L. Martin Company.

E. E. Aldrin, Aviation Manager, Atlas Supply Company.

Lawrence D. Bell, President and General Manager, Bell Aircraft Corporation.

George W. Brady, Chief Engineer, Propeller Division, Curtiss-Wright Corporation.

The Hon. W. A. M. Burden, Assistant Secretary of Commerce.

James H. Doolittle, Vice-President, Shell Union Oil Corporation.

Sherman M. Fairchild, Chairman of the Board, Fairchild Camera & Instrument Corporation.

C. C. Furnas, Director, Cornell Aeronautical Laboratory.

J. A. Herlihy, Vice-President—Operations, United Air Lines, Inc.

Jerome Lederer, Chief Engineer, Aero Insurance Underwriters.

John C. Leslie, Vice-President, Pan American World Airways System.

Carl de Ganahl, Director of Research, Kaiser Fleetwings, Inc.

Willson H. Hunter, in charge of the Refrigeration Section, Aircraft Engine Research Laboratory, N.A.C.A.

Elmer A. Sperry, Jr., Vice-President, Sperry Products, Inc.

Ernest G. Stout, Head of Naval Research, Consolidated Vultee Aircraft Corporation.

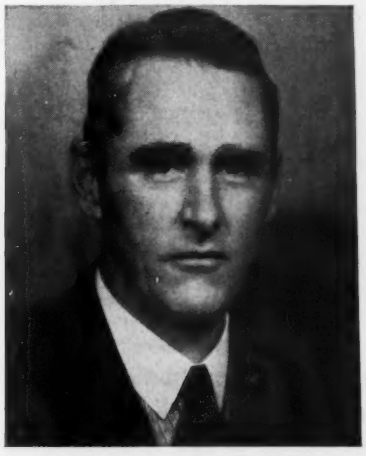
M. F. Stoughton, Project Engineer, Consolidated Vultee Aircraft Corporation.

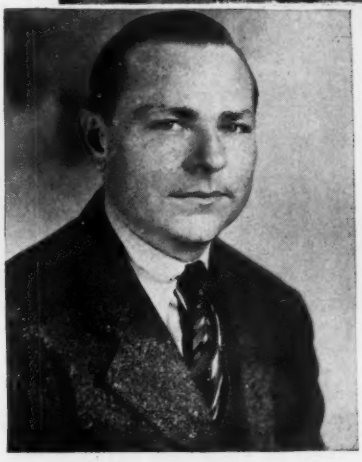
C. Fayette Taylor, Professor, Massachusetts Institute of Technology.

Earl D. Osborn, President, Edo Aircraft Corporation.

A. Elliott Merrill, Project Engineer, Flight Test Pilot, Boeing Aircraft Company.

John C. Squires, of Kelly, Soellner & Squires, Inc.

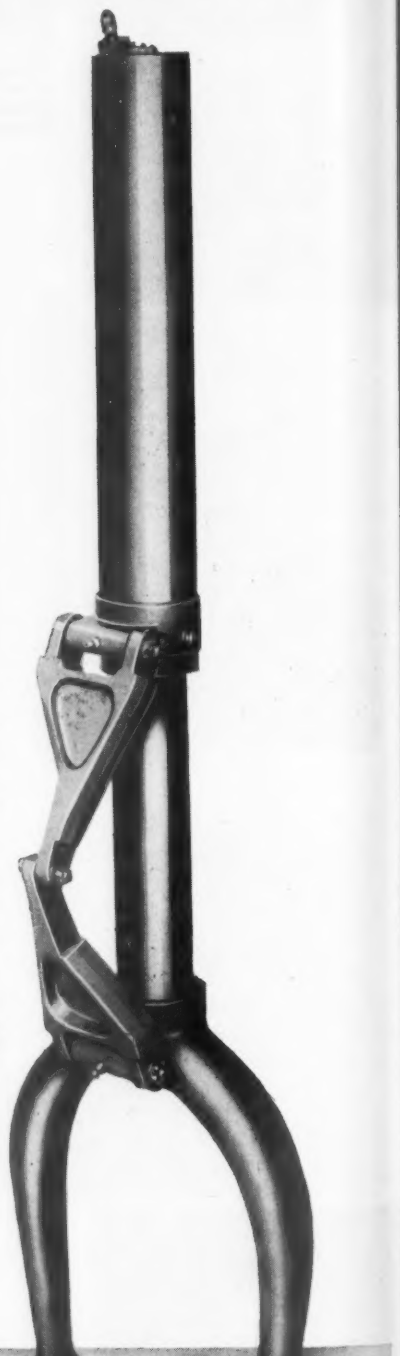




Area Council Representatives

ANOTHER NEW MEMBER OF ELECTROL'S LANDING GEAR FAMILY

is the nose wheel for tricycle airplanes



This new nose wheel strut weighs only 12½ pounds and can be used on light tricycle-type planes up to 3,000 pounds gross. Fixed or steerable installation. Retractable or non-retractable.

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President's Report for 1946

THE PAST YEAR has been an important one for the Institute in several respects. First came the transfer into new quarters at 2 E. 64th St., which, while accomplished in the rough by the time of the last Annual Meeting, required some weeks to complete to the point where all was functioning smoothly. The new building has proved to be well suited to the purpose: there is sufficient but not too much space, the location is convenient, and the carrying charges are reasonable.

Then came the change in administration with the appointment of S. Paul Johnston and the retirement of Lester D. Gardner. The new Director has amply covered the details of the year's operation in his report, thus relieving me of the task, and all that need be said here is to report to you that Mr. Johnston has performed his duties in a manner completely satisfactory to the officers and the Council, who feel that the difficult task of finding a worthy successor to Major Gardner has been accomplished.

Hardly had Mr. Johnston come into office before the effects of the postwar transition in industry became apparent in a serious drop in the Institute's income, and for several months operations were carried on at a loss. By the end of the year, however, this situation had been almost corrected, the deficit for the year being less than $5,000. A balanced budget had been set up for the future, which so far is being met, with some margin for later contingencies.

During the year, the number of Institute members has increased in a most gratifying way. A sustained effort is being made to improve the publications and meetings and to enlarge the service of the libraries, and there is every reason to believe that the effect of this policy will be to make the Institute attractive to a still greater number of professional men. The field of the aeronautical sciences is constantly broadening, which increases the number of those eligible for membership. To serve this field, Institute activities must likewise broaden. There has in the past been rather too much concentration of membership and of interest in the fields of aerodynamics and structures, but this is changing and it is a healthy change.

As a member from the Western Region, I should like to mention the situation there. The buildings that have been planned at Los Angeles and San Diego have been delayed by the restrictions that have only recently been removed. It is anticipated that they will both get under way during 1947, for in both cases the site is available, plans have been completed, and the necessary funds are at hand. The Seattle Section has been active during the year, and the organization of a San Francisco Section is now under way.

On the whole, the Institute has weathered the past year remarkably well, thanks to the continued support of its old friends and the added support of its new ones. The course for the future has been well charted, the captain and crew have been chosen, and we are on our way.

ARTHUR E. RAYMOND, *President*

Director's Report

AT A REGULAR MEETING of the Council of the Institute on January 30, 1946, the post of Director was formally tendered to the present incumbent, who was then (and for some months thereafter), on active duty with the United States Navy. Having been released to inactive duty in mid-April, he assumed the Directorate of the Institute on April 25, 1946.

As a means of coordinating internal activities, frequent staff meetings were inaugurated and have been continued throughout the year. On September 16, the first staff manual was posted and distributed to all I.A.S. personnel. This included an organization chart and defined the responsibilities of staff members in detail. A revision dated January 15, 1947, is now in effect.

The sudden death in September of William H. Dudley, the Institute's West Coast representative, made necessary some readjustment of the western setup. It was decided to appoint a Manager for the Western Region, responsible to the Director, to represent all Institute activities on the West Coast, including the administration of the Pacific Aeronautical Library, and the management of Institute properties there. On the recommendation of the West Coast Management Advisory Committee and with the approval of the Council, James L. Straight, formerly Committee Coordinator for the West Coast War Production Council, was hired as Manager, Western Region.

Publications

The reorganization plan of September 16, established a Publications Department in the Institute in charge of Welman A. Shrader, formerly Editor of the CATALOG. His responsibilities were subsequently increased under the current organization setup by adding all miscellaneous printing to his department.

JOURNAL.—The JOURNAL of the I.A.S. has remained substantially unchanged in appearance and policy throughout the year. Twelve issues were published with a total of 683 pages of text matter, and including some 76 separate technical papers.

REVIEW.—Beginning with the July, 1946, issue, certain changes in format were made: a new cover layout, new contents page, a rearrangement of "departments," and the inauguration of an Editorial page. Every succeeding issue has been carefully studied, and minor improvements have been made in typography and page layouts when they seemed appropriate.

During 1946 the REVIEW consistently lost money. Its income from all sources (advertising and subscription) has tended generally downward during most of the year. Until May, 1946, production costs had a definitely upward trend.

A budgetary control of costs and content was inaugurated in July, 1946. By planning issues well in advance, the size of the issue was related to the potential income from advertising in that issue. As a result of these changes, a reversal of trends occurred during the latter months of the year which cut the losses well below those anticipated.

CATALOG.—Because of paper and material shortages and printing delays, the 1946 CATALOG was not mailed until late in the year. It listed 92 separate paid advertisers (compared with 137 in 1945) and produced an income of $34,342 ($59,138 in 1945). Total costs were estimated at *$36,940* (*$36,502* in 1945), resulting in a net loss on the operation of approximately $2,598.00.

Membership

I.A.S. membership has shown a healthy growth during the year, an increase in total from 6,024 to 6,479, or 455. Student membership went from 1,035 to 1,655 (up 620), making a total membership increase from 7,059 to 8,134 or 1,075 total for the year.

Section activities are on the increase. Fourteen Sections, with a total of 4,160 active members, held 72 meetings. Two Sections (Dallas and Phoenix) suspended during the year, but Dallas has been reactivated. The first Section

outside of United States was activated at Toronto recently. Dayton and San Francisco Sections are being reorganized.

Student Branches have been active. The Secretary reports that 38 Branches are in operation, with 1,655 members. They held 210 meetings during the year.

Meetings and Activities

During the course of the year six annual meeting events took place.

Fourteenth Annual Meeting (New York)	January 28–31
National Aircraft Propulsion Meeting (Cleveland)	March 21
National Light Aircraft Meeting (Detroit)	June 13–14
Annual Summer Meeting (Los Angeles)	July 18–19
National Air Transport Meeting (Washington)	October 24
Wright Brothers Lecture (Washington)	December 17

In addition to these meetings, several trips to Army and Navy facilities, all of which were exceedingly popular, were organized for members. These included a two-day visit to Wright Field in October. In addition, the Navy made available two aircraft carrier trips at sea for Institute members. The first took place on April 29–30 aboard the U.S.S. "Tarawa" from New York, and the second out of San Francisco aboard the U.S.S. "Boxer" on November 7. Following the "Tarawa" expedition, members were given an opportunity to inspect the Naval Air Testing Station at Patuxent, Md.

Library Activities

An Industry Conference on Aeronautical Library Research Facilities was held on October 7, 1946, at the I.A.S. building in New York. It was attended by 52 research engineers and librarians from 33 companies.

The Fiscal Year beginning October 1, 1945, was occupied during its first few months by the packing and moving of the collections to the new building. The Reading Room was closed during December and January, reopening in the new location on February 4, 1946. All of the parts of the collections that were in storage at Daniel Guggenheim Park, Sands Point, L.I., and in storerooms at Rockefeller Center are now in the new building, where they are on display or are available for use.

The hours of the Library were increased in October to include Saturdays from 9:30 a.m. to 5:30 p.m. and Thursday evenings. On all weekdays the Library is open from 9:00 a.m. to 5:30 p.m., on Thursdays until 10:00 p.m.

Loans by mail to nonmembers of the Institute were resumed in April, 1946. This service was suspended in October, 1944, because of difficulties in obtaining mailing cartons. The lending rules were changed during the year to increase services by extending the loan period to 2 weeks and by increasing the number of books loaned at one time from one to three.

Membership in The Paul Kollsman Lending Library increased by 314 during the year to a total of 4,417. A total of 1,450 books was added, of which 542 were gifts, 439 were review copies sent by publishers to the AERONAUTICAL ENGINEERING REVIEW, 344 were purchased, and 125 were bound periodicals. The total number of volumes in the New York and Los Angeles libraries is 33,376. In addition to books, 75 foreign periodicals were added to the 375 being received regularly, and a few books from foreign countries were received for review and by purchase.

Microfilm received and filed during the year included 422 German and Japanese documents, each in a separate container, and 8,950 of such documents on 459 reels, averaging a little under 20 documents per reel.

In October the Museum was opened to the public on Tuesday and Thursday afternoons from 1:00 to 4:00 p.m. It is available to Institute members and representatives of Corporate members at any time during the day. The number of visitors to the Museum has averaged 30 per month, about two-thirds of whom are Institute members.

Guggenheim Park

During the entire calendar year 1946 the U.S. Navy occupied the premises at Sands Point. The new lease, which has been approved by the Council at the meeting on January 30, 1946, was signed by the Navy and went into effect on July 1, 1946.

S. PAUL JOHNSTON, *Director*

Treasurer's Annual Report

THE FISCAL YEAR ending September 30, 1946, revealed that the assets of the Institute, including restricted funds set up for awards, endowments, buildings, etc., has reached an all-time book value high of $1,703,209.04. Our property at Sands Point, N.Y., which is assessed at $454,450; the value of our Library and Archives collections; appreciation of over $200,000 in the value of investments; furniture and equipment; and the Aeronautical Index file are carried on the books at a nominal value of $1.00.

For a society completing its fifteenth year, this achievement in financial growth and stability is indeed a tribute to the men who had the foresight and ability to raise the "infant" to such an enviable position.

This financial position was deemed desirable and necessary by the Council in order to provide a sound footing on which management could operate in future years. It is acknowledged that many members have felt and still feel that current income should be utilized on immediate services to the membership rather than provide for reserves. However, it was realized during the war years, that an accumulation of reserves, surplus, and funds for special purposes should be provided in order to maintain services in the postwar period when income from memberships might decline, when advertising income from the publications would only meet their own operating costs, and when income from corporate dues would decline because of withdrawals of companies from the field.

This condition has been exemplified by the operations during the past year when the Institute, for the first time, incurred a deficit of $4,734.23. Had the society followed a policy of increasing services, with a corresponding increase in expenses, to the limit of its income each year, then a deficit operation in subsequent years would have been serious.

As the Institute has ample reserve and surplus funds, a slight loss such as this during the readjustment period was easily assimilated without any reduction of services to members and the industry.

A balanced budget for the year October 1, 1946, to September 30, 1947, has been approved by the Council and is now in operation.

As in previous years, the details of the operations of the Institute are presented under their appropriate headings to enable the membership to see the costs of the various functions. The accompanying Financial Statement for the period October 1, 1945, to September 30, 1946, comprises a consolidated balance sheet showing the assets, liabilities, and unexpended income; a consolidated statement of income and expenses; and details of the income and expenses of the JOURNAL OF THE AERONAUTICAL SCIENCES, the AERONAUTICAL ENGINEERING CATALOG, the AERONAUTICAL ENGINEERING REVIEW, and the cost of the Library.

The books of account of the Institute were examined by Patterson and Ridgway, Certified Public Accountants. In their report they state that the Balance Sheet and related statements of income and expenses fairly present the financial position of the Institute at September 30, 1946, and the results of operations for the fiscal year ended that date.

C. S. JONES, *Treasurer*

INSTITUTE OF THE AERONAUTICAL SCIENCES, INC.

Statement for the fiscal year October 1, 1945, to September 30, 1946

Consolidated Balance Sheet and Operating Statement

ASSETS

General Fund Assets:		
Cash on Deposit and Petty Cash		$ 39,007.40
Accounts Receivable		36,131.09
Advances on Contracts, etc.		10,619.56
Deposits and Prepayments		2,265.76
Furniture and Fixtures		5,000.00
Investment Accounts:		
Benefactor Membership Fund:		
U.S. Treasury and Savings Bonds at par.		52,345.60
Postwar Contingencies Fund:		
U.S. Treasury Bonds at par		189,000.00
Daniel Guggenheim Park (Assessed Value—$454,450.00		1.00
Books, Prints, Models, Medals, etc.		1.00
Aeronautical Index		1.00
Total General Fund Assets		$334,372.41
Restricted Fund Assets:		
The Sherman M. Fairchild Fund:		
U.S. Treasury Bonds at par.	$ 25,654.40	
Cash on Deposit	1,657.65	$ 27,312.05
The Paul Kollsman Fund:		
U.S. Treasury Bonds at par.		69,000.00
The Vernon Lynch Award Fund:		
U.S. Treasury Bonds at par.	3,000.00	
Stocks	14,260.00	
Cash on Deposit	881.83	18,141.83
The Minta Martin Aeronautical Fund:		
U.S. Treasury Bonds and Stocks	481,907.96	
Cash on Deposit	11,561.46	493,469.42
The Sylvanus A. Reed Award Fund:		
U.S. Treasury Bonds at par.	12,000.00	
Cash on Deposit	1,266.18	13,266.18
The Lawrence Sperry Award Fund:		
U.S. Treasury Bonds at par.	12,000.00	
Cash on Deposit	1,011.16	13,011.16
New York Building Fund:		
U.S. Treasury Bonds at par.	110,000.00	
Building and Property	204,010.01	
	314,010.01	
Less—Advance from General Fund	4,179.51	309,830.50
*Los Angeles Building Fund:**		
U.S Govt. C. of I. at par.	160,000.00	
Building (in process) and Land	79,109.32	
Cash on Deposit	20,494.92	259,604.24
*San Diego Building Fund:**		
Certificates of Deposit	155,500.00	
Building (work in process)	1,992.00	
Cash on Deposit	7,709.25	165,201.25
Total Restricted Fund Assets		$1,368,836.63

LIABILITIES, FUNDS AND UNEXPENDED INCOME

General Fund:		
Accounts Payable		$ 27,554.02
Deferred Credits to Income (Dues & Subscriptions)		35,162.13
Withholding Taxes		3,694.10
Reserve for Postwar Contingencies		189,000.00
Unexpended Income:		
Balance September 30, 1946		78,962.16
Total General Fund Liabilities and Unexpended Income		$334,372.41
Restricted Funds:		
Principal of gifts and unexpended income (See Assets)		
Total Restricted Funds Liabilities		$1,368,836.63

*1944–1945 Balances. Detailed report not received in time for publication.

Statement of Income and Expenses—General

INCOME

Dues (less subscriptions)	$124,033.51	
Entrance Fees	2,715.00	
Interest on Investments, etc.	6,985.46	
Donors	3,581.09	
Miscellaneous	554.75	
Excess of Income over Expenses:		
Journal of the Aeronautical Sciences	3,114.40	
Total Income		$140,984.21

EXPENSES

Accounting and Clerical Salaries	$ 65,756.01	
General Office Expenses	52,570.47	
Excess of Expenses over Income:		
Aeronautical Engineering Review and Library	24,818.88	
Aeronautical Engineering Catalog	2,573.08	
Total Expenses		145,718.44
Net Unexpended Income for the Period Ending September 30, 1945 (Deficit)		$ 4,734.23

Detail of Journal, Review and Catalog Income and Expenses

Review and Archives

INCOME

Revenue	$ 94,844.59	
Subscriptions	13,871.42	
Interest on Investments, etc.	3,227.73	
Miscellaneous	476.21	
Total Income		$112,419.95

EXPENSES

Aeronautical Archives and Libraries	$ 28,505.86	
Editorial and Clerical Salaries	44,492.07	
General and Publication Expenses	64,240.90	
Total Expenses		137,238.83
Excess of Expenses over Income—See Institute Expenses		$ 24,818.88

Journal

INCOME

Subscriptions	$ 26,837.82	
Total Income		$ 26,837.82
EXPENSES		
Editorial and Clerical Salaries	$ 6,136.84	
General and Publication Expenses	17,586.58	
Total Expenses		23,723.42
Excess of Income over Expenses—See Institute Income		$ 3,114.40

Catalog

INCOME

Revenue	$ 34,342.21	
Reprints	24.66	
Total Income		$ 34,366.87
EXPENSES		
Editorial and Clerical Salaries	$ 14,575.00	
General and Publication Expenses	22,364.95	
Total Expenses		$ 36,939.95
Excess of Expenses over Income—See Institute Expenses		$ 2,573.08

I.A.S. Establishes First Section Outside U.S.A.

On January 15 the initial meeting of the Toronto Section marked the organization of the first Section of the I.A.S. to be established outside the United States. For a long time aeronautical engineers in the area had felt a need for regular meetings devoted to technical papers and discussions. Wartime restrictions and customs problems, however, had precluded affiliation with the Institute. In October of last year, largely due to the efforts of Bernard Etkin, of the University of Toronto, organization plans got under way. Letters were circulated to members in the area and to nonmembers who might be interested. The response was extremely gratifying and a Provisional Committee was set up to plan the organization meeting. Seventy-five members and applicants were present at this meeting on January 15.

The Institute welcomes the Toronto Section with the hope that the result will lead to closer cooperation between engineers in the two countries. Now that border restrictions are no longer in effect the free services of The Paul Kollsman Lending Library are being made available.

A full account of the meeting may be found under "Sections and Branches" in this issue.

Davidson Appointed to Policy Board of *Applied Mechanics Reviews*

Dr. Kenneth S. M. Davidson, Director of Experimental Towing Tank Laboratory, The Stevens Institute of Technology, and an Associate Fellow of the Institute, has been appointed I.A.S. representative on the Policy Board of the proposed publication, *Applied Mechanics Reviews*.

This publication will be an English abstracting and reviewing journal of the world research literature in the field of Applied Mechanics. The following branches of this field will be included: Mechanics of Rigid Bodies; Fluid Mechanics; Vibrations and Wave Motion; Testing and Strength of Materials; some aspects of Heat and Thermodynamics; and Measurements, Instrumentation, and Similar Techniques.

The *Applied Mechanics Reviews* will be published by the American Society of Mechanical Engineers with the cooperation of the Institute of the Aeronautical Sciences; the Institute of Physics; the American Society of Civil Engineers; the American Mathematical Society; and the Society for Experimental Stress Analysis. Other societies, including some European societies, are expected to join later.

George F. Chapline.

Chapline Appointed General Manager of Ranger Aircraft

George F. Chapline, Associate Fellow of the Institute, has been appointed General Manager of the Ranger Aircraft Engines Division, Fairchild Engine and Airplane Corporation.

Mr. Chapline has had a long and eventful career in Naval Aviation and in the aircraft industry. As Vice-President of Wright Aeronautical Corporation and, later, as President of Brewster Aeronautical Corporation, he became intimately familiar with industrial and commercial aviation. A graduate of Annapolis, he has also completed postgraduate work in aeronautical engineering at Massachusetts Institute of Technology. An experienced pilot, Mr. Chapline returned to the Navy in the recent war and saw active service in the Pacific as a Captain on Admiral Nimitz' staff.

Mr. Chapline has been Assistant General Manager since joining Ranger in the early part of 1946.

Eugene W. Norris.

Major Gen. Clements McMullen, Deputy Commander, Strategic Air Command

Major Gen. Clements McMullen, an Associate Fellow of the Institute and former Commander of the Eighth Air Force, is the new deputy commander of the Strategic Air Command.

General McMullen, a veteran of nearly 30 years' service with the Army Air Forces, returned from an assignment as Chief of Staff of the Pacific Air Command last November to head the Eighth Air Force. Prior to his service as Pacific Air Commander, General McMullen commanded the Far East Air Service Command. His new assignment brings him to Strategic Air Command headquarters at Andrews Field, Md., to serve under General Kenney.

Norris Elected Vice-President of Luscombe

Eugene W. Norris, Associate Fellow of the Institute and Chief Engineer, Luscombe Airplane Corporation, has been appointed Vice-President in charge of engineering.

A private pilot with more than 600 hours flying time to his credit, the new 32-year-old Vice-President is a graduate of the Guggenheim School of Aeronautics, New York University. Later, he did postgraduate work at The Johns Hopkins University in advanced aerodynamics and propeller design. He formerly was Director of the Technical Service for the Aircraft Industries Association and enjoys an additional aircraft background with Beech Aircraft Corporation, The Glenn L. Martin Company, and the C.A.A. From 1938 to 1942 he was Chief of the Aircraft Engineering Specifications Branch, C.A.A.

McDonnell Aircraft Appoints Don R. Berlin Vice-President

Don R. Berlin, a Fellow of the Institute with a distinguished career as an aeronautical engineer and engineering executive for a quarter of a century, has been elected Vice-President of McDonnell Aircraft Corporation. He will be in charge of aircraft contracts and engineering.

From 1921 to 1926 Mr. Berlin worked in the Engineering Division, U.S. Army Air Corps, at McCook Field, Dayton, Ohio. During this period he was in charge of wind-tunnel tests in the Aerodynamics Laboratory.

Mr. Berlin started as a detailer with the Douglas Aircraft Corporation in February, 1926. By the end of one year he was Project Engineer on a twin-engined, Navy torpedo plane. In 1928 he was made Chief Draftsman.

Don R. Berlin.

At the Valley Manufacturing Company, Glendale, Calif., Mr. Berlin held the position of Chief Engineer. From February to October, 1929, he designed and built an eight-place, three-engined airplane. This plane was completely tested during this period and later was used on the Air Mail route in Guatemala.

Mr. Berlin was with the Northrop Aircraft Division, United Aircraft Corporation, Burbank, Calif., for 2 years.

In 1934 he joined the Airplane Division of Curtiss-Wright, Buffalo. He was Project Engineer on the XP-36 pursuit plane until January, 1936. The famous series of fighters, the P-36 through the P-40 followed this. Mr. Berlin served as Chief Engineer from January, 1936, to January, 1941, and afterward became Director of Engineering for the Airplane Division of Curtiss-Wright.

As Director of Aircraft Development in the Fisher Body Division, General Motors Corporation, Detroit, he supervised development of the XP-75 experimental long-range fighter and the P-75 production model. After Fisher disbanded its aircraft division, Mr. Berlin became Director of the Installations Engineering Section, Allison Division, General Motors, at Indianapolis.

American Helicopter Society Announces March Meeting

The Third Annual Philadelphia Forum of The American Helicopter Society, Inc., will be held in Philadelphia on March 27, 28, and 29.

Meetings on Thursday and Friday will cover Technical Developments, Service Testing, Operations, and Economics of the Helicopter. Saturday will be devoted to helicopter exhibits and flights.

Those desiring programs of the meeting may obtain copies through the General Chairman, Paul Thomas, 12 South 12th St., Philadelphia, Pa.

Gifts to the Institute Collections

A model of an F4U-4 Corsair fighter airplane was received from the Chance Vought Aircraft Division of the United Aircraft Corporation. A Gordon Bennett medal of 1910, a Curtiss Marine Flying Trophy medallion of 1915, and an Aero Club of America medal of 1908 were sent by Mrs. Laura M. Stevens, adding to her previous generous gifts and those of her late husband, A. Leo Stevens. Prof. Felix W. Pawlowski sent a copy of his "Michigan to California March" for addition to the collection of sheet music. Mrs. Bella C. Landauer added etiquettes and air labels and other gifts to those she had previously sent. Le Roy V. Coburn added air labels to his previous gifts.

Aeronautical periodicals were received from John Rogers, of Philadelphia; the Eclipse-Pioneer Division of Bendix Aviation Corporation, through the courtesy of Miss Mildred M. Baker; and the Propeller Division of Curtiss-Wright Corporation, through the courtesy of Miss Helen M. Coffin. A copy of lecture notes for a course in aeronautical dynamics was received from Prof. Manfred Rauscher. Col. Stedman Shumway Hanks added to his previous generous gifts through the courtesy of Mrs. Hanks.

Additional gifts were received from *Aero Digest*; Eastern Air Lines, Inc.; *Flying*; Hornblower & Weeks; Lycoming Division of The Aviation Corporation; New Zealand Air Mission; Pan American Airways, Inc.; United Air Lines, Inc.; and the U.S. Army Air Forces, Civilian Production Administration, Civil Aeronautics Administration, Forest Products Laboratory, Department of Labor, Library of Congress, Bureau of Mines, Navy Department, Post Office Department, Smithsonian Institution, War Assets Administration, Senate committees on interstate commerce and post offices and roads, and the House and Senate document rooms.

News of Corporate Members

The General Electric Company's Aircraft Gas Turbine Division has announced a 2-year expansion program, including construction of a new laboratory and increased production facilities for aircraft jet engines of advanced design.

A one-story all-concrete structure, comprising 25,000 sq.ft. of floor space with series of chambers to test jet engines during various manufacturing stages, is under construction at the G-E River Works. Costing approximately $500,000, the test-cell project is expected to be in operation early this year.

Pan American World Airways System will be the first air line to use the new Curtiss-Wright Dehmel Electronic Flight Trainers. Cockpit controls will be simulated for both the Republic Rainbow and the Boeing Stratocruiser. The use of these trainers is intended to shorten training time by one-third. Delivery is scheduled for next summer.

Sections and Branches

Buffalo Section

By Peter O. Tauson, *Secretary*

K. D. Swartzel, Cornell Aeronautical Laboratory, presented a paper, "Radio Telemetering," at a meeting, November 21, at the Westbrook Hotel.

Mr. Swartzel stated that the accurate recording of flight data by radio transmission of datum signals to a ground receiving station is an essential art in the flight-testing business. This talk described and illustrated apparatus developed by the Curtiss-Wright (Airplane Division) Research Laboratory. The equipment can transmit as many as 14 separate data, supplying a continuous record of each one. The highest frequency component in any transmitted datum is 200 cycles per sec. (or less if desired).

The method of operation is to generate 14 constant-frequency "tones" in the flying equipment. The frequency of the lowest tone is 10.8 kc.; of the highest, 43.3 kc. The amplitude of each tone is regulated by a gage designed for the purpose to make the "loudness" of the tone correspond to the value of the corresponding datum (e.g., pressure,

Calendar

I.A.S. Section Meetings

BUFFALO—MAY 22
Niagara Room, Statler Hotel
Speaker: Dr. Alexander Klemin
"Present Status of Helicopter Performance and Design"

PHILADELPHIA—APRIL 1
Engineer's Club of Philadelphia, 1317 Spruce St.
Speaker: Edward Seckel, Princeton University
"Flapping and Drag Hinges on Helicopters"

NEW YORK—APRIL 23

SAN DIEGO—APRIL 4

acceleration, structural strain, displacement of control surface). The chord produced by combining the 14 tones, each varying in amplitude as dictated by its datum, is transmitted to the ground by FM radio.

On the ground, the composite chord of 14 tones is separated into its component notes by heterodyning and filtering the 14 high-performance crystal filters. The amplitude levels are separately recorded in a mobile receiving station.

Sonic records obtained in practical flight-test work, with a Navy SB2A airplane, were shown as part of the illustrative slides.

Eighty-seven members met at the Fillmore Room, Hotel Statler, January 9, to hear two papers by Bell Aircraft Corporation engineers. Stuart K. Edleson, Chief, Rocket Design Engineer, spoke on "Rocket Power Plant." Norvin E. Erickson, Rocket Research Engineer, discussed "Development Testing of Rocket Motors."

Mr. Edleson's talk covered the basic consideration connected with engineering aspects of the design of the rocket motor, the difficulties encountered because of the extreme heat and high energy release, and means of effectively compromising the design for a satisfactory solution of this difficult problem.

Mr. Edleson's talk was followed by a second discussion by Norvin E. Erickson who described the instrumentation and the test conditions for rocket motors. The method of solution of some of the most difficult problems outlined by Mr. Edleson were shown by Mr. Erickson's paper.

The consensus of the papers was that a great deal more work will have to be done in the engineering and experimental fields before rocket motors reach any degree of perfection.

Dr. Alexander Klemin, Aeronautical Consultant and a Fellow of the Institute, will present a paper, "Present Status of Helicopter Performance and Design," May 22, in the Niagara Room of the Statler Hotel, Buffalo. Members of other Sections are invited to attend.

Detroit Section

By Robert Dale, *Secretary*

On January 14 a joint I.A.S.-A.S.-M.E. dinner was held at the Rackham Memorial Building with an attendance of 150. After the dinner, Mr. Walker, of the A.S.M.E., introduced the dinner speaker, Col. David Schilling, Commander of the 56th Fighter Group, Selfridge Field. Colonel Schilling spoke of the history of Selfridge Field and of the Fighter Groups of the past and present. He mentioned many notables who in the past have been active at Selfridge Field. Colonel Schilling then described the future program of the 56th Fighter Group and the affiliated reserve program. He pointed out that some 2,000 personnel are now active as Reserves and that there is a potential of 7,000 personnel. The group then adjourned to the auditorium.

Dr. Furnas gave an unusual analysis of the future of three fields of aviation from an economic approach. He divided his talk into Commercial, Private, and Military Aircraft, dealing primarily with the commercial airplane. Three questions were then stated to analyze the commercial field from the manufacturer's point of view: (1) How large is the future commercial airplane to be? (2) How fast? (3) How many?

For question one, he based his analysis on two factors—economics and the public's desires. From this it was concluded that 50- to 60-passenger airplanes were the peak for continental travel in the United States and about twice this for transoceanic travel, based on a period from 1940 to 1950.

Question two was answered in regard to cost, based on the present method and type of airplane being operated. He stated that the faster you go, the higher the cost. The optimum speed arrived at, for the above-mentioned period, was from 250 to 300 m.p.h. Probably some special classes would be willing to pay extra for higher speeds so that a potential maximum of 400 to 600 m.p.h. would be reasonable.

Question three was discussed by analyzing several types of growth curves, both of people and industries. By studying several such curves, it was easy to see what type of growth might be expected of the commercial airplane field. It was predicted that by the year 1950 some 1,200 to 1,400 airplanes would be required by the commercial air-line industries. As to cargo airplanes they will increase greatly but will never bother the railroads.

Dr. Furnas then discussed private airplanes by saying that they are not now a practical means of transportation and will not be for many years. Possibly the rotary wing craft will change this. However, in this field, the predominant consideration is cost.

The military airplane was not discussed because of security reasons. However, Dr. Furnas did say that large amounts of money were being spent and that whether or not the public realized it, they would benefit from the developments that were being and would be made.

A short question-and-answer period was held following the talk.

Hagerstown Section

By G. I. Hackenberger, Jr., *Secretary*

The Hagerstown Section's first meeting of the new year, January 22, was preceded by an informal dinner with the speaker of the evening, Lester D. Van Valkenburg, Aerodynamicist for the Fairchild Pilotless Planes Division, as guest of honor.

The meeting was called to order by the Chairman, Joel M. Jacobson, who announced that a prize of $100, donated by the Fairchild Aircraft Division, would be awarded for writing the best paper for presentation. Papers will be submitted for possible inclusion in the Institute publications.

Henry Billings, Program Chairman, introduced Mr. Van Valkenburg, who delivered an interesting paper on "The Design of Supersonic Aircraft."

Mr. Van Valkenburg began by stating in general terms the problems confronting the supersonic aircraft designers, stressing the fact that established methods and principles do not apply to supersonic work. He stated that it is necessary to develop completely new procedures. After presenting a brief background, he proceeded to a discussion of the characteristics of airfoils at supersonic speeds, illustrating pressure distribution and the effect on lift and drag coefficients of variations in incidence and thickness ratio at various Mach Numbers. Wing plan form and sweepback were discussed.

In treating fuselage design, it was shown that the most efficient nose shape is an 8° cone. Other factors were mentioned, including treatment of wing and fuselage combinations.

On the subject of performance Mr. Van Valkenburg stated that specification performance requirements for supersonic aircraft are rather broad, the mission, or nature of the flight path, coming in for primary consideration. The differences between the long-range, no-maneuverability and short-range, extreme-maneuverability types were illustrated.

After touching briefly on both rocket and jet power plants and factors affecting the operation of each, Mr. Van Valkenburg concluded by sketching ideal shapes for supersonic aircraft explaining the reasons for each step in the design. A brief discussion followed.

San Diego Section

By William B. Barkley, *Corresponding Secretary*

On December 18, 1946, the Executive Committee met to discuss the architectural treatment of the facade of the proposed Section Building in San Diego. From several perspective sketches supplied by the Architect, the Executive Committee decided upon one sketch that best conveyed the dignity of the activities housed therein. It was then proposed that this sketch with the Executive Committee's recommenda-

tion be forwarded to the Contributors Committee.

On January 10, 1947, the San Diego Section held a General Membership Meeting. The speaker of the evening was R. E. Marquardt, M.I.A.S., President, Marquardt Aircraft Company of Venice, Calif. Mr. Marquardt spoke on "Subsonic Ram Jet Engines." In addition to Mr. Marquardt's paper, two motion pictures, *Modern Magic Carpet* and *Planes Without Pilots*, were shown.

On February 3 the Advisory Management Committee of the Section met to discuss the matter of a lease on the proposed building site for the Section Building. Jack Mason, Building Committee Chairman, told the Management Committee that a lease incorporating all revisions that, to date, had been deemed desirable had been received from the City Attorney's office via the San Diego Harbor Committee.

After analyzing the document thoroughly, the Management Committee resolved to accept the lease as written and recommended that the Contributors Committee forward it to the New York Office of the Institute for final approval.

The next regularly scheduled meeting of the Section will be February 28, at which time Harold K. Cheney will speak on "Flight Testing for Guided Missiles."

Texas Section

By R. F. Pence, *Secretary*

A meeting was held on January 15 in the French Room of the Blackstone Hotel, Fort Worth, Tex., to reactivate the Texas Section. Approximately 60 members and guests attended. This was the first meeting in more than a year, and the sole remaining active officer, Treasurer H. T. Johnson, presided.

The following officers were elected: Chairman, H. T. Johnson; Vice-Chairman, O. N. Thompson; Secretary, R. F. Pence; and Treasurer, W. H. Barling.

The guest speaker was B. A. Erickson, XB-36 Project Test Pilot for Consolidated Vultee, who spoke on "Flight Testing the XB-36." The general impression gained from Mr. Erickson's remarks was that the XB-36 is a good airplane and that the years of effort spent in designing and building it are justified by the results. Moving pictures of some of the early flights of the XB-36 were shown by Fred Carlile. Following the pictures, Mr. Erickson conducted a period of open discussion.

Toronto Section

By Carl V. Lindow, *Secretary*

It is a pleasure to introduce to the members of the Institute, the Toronto Section. We of the Toronto Section are proud of the distinction of being the first Section ever to be organized outside of the United States.

The organization meeting was held on January 15 at Hart House, University of Toronto, with about 75 members and interested nonmembers in attendance. The following officers were elected: Chairman, Bernard Etkin, University of Toronto; Vice-Chairman, Richard D. Hiscocks, de Havilland Aircraft; Secretary, Carl V. Lindow, A. V. Roe Canada Limited. Advisory Board: T. R. Loudon, University of Toronto; W. U. Shaw, A. V. Roe Canada Limited; and William H. Jackson and A. F. MacDonald, de Havilland Aircraft.

Following the election of officers, motion pictures were shown and an interesting talk was given by Kenneth Hay-Roe, of Bell Aircraft, on the subject "Helicopters." Pictures of some of the tests performed by Bell engineers on powered models were shown, and Mr. Hay-Roe explained how the instability in rough air was overcome by use of the stabilizing bar. The advantages of the rigid rotor over the flapping hinge type were outlined. One difficulty with the latter is the flapping lag due to blade inertia, which tends to destabilize the aircraft. It was mentioned that there were simple schemes being tried which will do away with the antitorque rotor on single-rotor designs. Unfortunately, the speaker was not free to elaborate on any of these. Mr. Hay-Roe allotted considerable time to the discussion of the application of jet propulsion to helicopters and what developments may be expected along this line in the near future. The light weight and cheapness of the jet units and their great increase of efficiency with speed are good arguments in favor of mounting jets in the rotors. Of course, at the present stage of development the high fuel consumption of jet engines is a definite hindrance. However, it was apparent from the speaker's remarks that the use of jet propulsion was bound to make possible great advances in helicopter design.

The lengthy discussion period that followed brought out many of the finer points involved both in the design and operation of the helicopter. So enthusiastic were some of the members that Chairman Ben Etkin finally found it necessary to declare the discussion period at an end so that the speaker might retire.

On February 6 the Executive and the Advisory Board are to meet for the purpose of appointing the necessary committees and setting the date for the next meeting.

If the initial meeting can be considered any indication, the Toronto Section may look forward to an extremely successful year.

Washington Section

By Katherine Stinson, *Secretary*

The second Section meeting of the 1946–1947 season was held at the U.S. Chamber of Commerce Building, January 8, 1947.

Comdr. T. D. Davies spoke on the "Record Breaking Flight of the Truculent Turtle." In his talk, which was illustrated with slides and a motion picture, Commander Davies discussed some of the technical aspects that were not covered in the newspaper accounts of the long-distance flight.

At the close of the lecture the meeting was thrown open to discussion.

It was announced by Chairman Robert Littel that the next meeting would be held, February 12, at the U.S. Chamber of Commerce Building. J. P. Perry, Chief Engineer, Firestone Aircraft Company, will speak on helicopters.

Academy of Aeronautics

The "Student Lecture Award" competition was held, January 7, at La Guardia Field. The first speaker was Calvin Leinwand. Mr. Leinwand spoke on "Air Traffic Jams." He discussed a problem confronting the large airports today—that of handling large numbers of landings during bad weather. The subject of "Fuel Injection for Small Aircraft" was presented by Joseph Di Mauro, who pointed out the advantages of fuel injections in the engine performance. Horace B. Edwardsen's report was entitled "Engineering in the Airlines." This talk described the many fields of engineering which are necessary in the successful operation of an air line, such as flight engineers, maintenance engineers, and production engineers.

A Bell Aircraft technicolor sound film, *Report on Jet Propulsion*, was shown at the meeting on January 21. Thirty members and 25 affiliate members were present.

The Aeronautical University, Inc.

The monthly business meeting was held, January 9, at the Aeronautical University's Engineering Building. The election of officers for the coming semester are as follows: Chairman, Ralph N. Nelson; Vice-Chairman, William E. Stakee; Secretary, Albert J. DeVries; Treasurer, Theodore Kelly; and Sergeant at Arms, George L. Frame.

The Speakers Committee gave a report relative to a technical lecture to be presented on February 12 by a representative from Westinghouse Electric Corporation.

The officers of the Student Branch and faculty members announced the

two Institute award winners for the fall term. The Scholastic Award was presented to Leonard M. Miller and the Lecture Award to George J. Egner, Jr.

University of Cincinnati

On December 5, 1946, 45 members attended a joint business and technical meeting at the Student Union Building. Milton J. Spector was elected Vice-Chairman. A film describing the Bell helicopter was shown.

The Weston Memorial Award of $100 for the highest average grade in the Senior Class was presented to Maynard I. Weinstein at a meeting on December 12. Second place, $75, went to Leonard Segel. The Awards are given in honor of a former student in the Aeronautical Engineering Department who was killed during the war.

Clinton Van Pelt presented a paper, "The Mold Loft and Its Duties."

Four meetings were held during January. On January 9, 40 members met in the Student Union Building to discuss plans for Student Branch social activities. A film, *Destruction Test of a Martin PBM Wing*, was shown.

On January 16 Vice-Chairman Milton J. Spector presented a paper, "Comparison of Performance Between Models and Full-Size Airplanes." The speech was a summary of an N.A.C.A. report by Eastman Jacobs, with comments by the speaker.

Walter Buchman, Aeronautical Engineering Coordinator, spoke on "The Present Condition of the Aviation Industry," at a meeting on January 23. A committee was appointed to prepare a tentative list of suggestions for course improvements. The list was to include suggestions of courses to be added or deleted, methods of teaching, and equipment needed. The report will serve as a basis of discussion for a larger report to be prepared by the group as a whole.

Chairman Arthur C. Nolte led an informal discussion on the Student Branch social activities at a meeting on January 30.

University of Illinois

Fifty members attended a meeting on January 9 of the Student Branch. Prof. H. E. Babitt discussed the engineer's present economic position in his paper, "Illinois Professional Engineering Act." He pointed out the advantages of the professional engineering society and its license requirements.

Indiana Technical College

Twenty-five members attended the Student Branch meeting, January 13. A film, *Willow Run Plant*, described the production of Consolidated B-24 bombers and the rapid, wartime construction of the plant. The film explained assembly-line methods that made possible the production of one bomber per hour.

Plans were discussed for a field trip to Dayton, January 24. The local Student Branch of mechanical engineers (A.S.M.E.) will also participate in this project.

University of Kansas

The Student Branch meeting of December 12 was opened by Chairman Billy B. Lash with a discussion of the Engineering Exposition, which is held on March 21 of each year. Following a short business session, Prof. L. R. Laudon, Head of the Geology Department of the University of Kansas, presented a paper on his field trip to Alaska.

University of Michigan

Fifty-four members attended a joint business and technical meeting on December 18 at the Michigan Union Building. A group picture for the Michigan Year Book was taken at the beginning of the meeting. Following a discussion of the advisability of forming a chapter of Gamma Alpha Rho fraternity, Prof. W. C. Nelson presented a paper on "Supersonic Design Problems."

Purdue University

On December 17 a joint technical session and business meeting was held at the Aeronautical Engineering Building. Frank M. Crosby delivered a paper, "Flight Testing of the XP-59." Nominations for next term's officers were set for the next meeting.

On January 13 nominations for officers were made, and it was announced that balloting would begin on January 20. It was reported that the I.A.S. banquet would be held at 7:15 p.m., January 30.

A film, *Construction and Flight Testing of a Light Plane*, was shown.

Stanford University

The Stanford Student Branch held its first meeting on January 21. The following officers were elected: Chairman, Machlin B. Laddon; Vice-Chairman, Arthur S. Benson; and Secretary and Treasurer, Robert D. Wilkinson. A tentative program for future meetings was discussed.

A film of the "Able" and "Baker" operations at Bikini was shown. Prof. H. H. Skilling, an official observer of the operations, interpreted the film and later answered questions.

University of Tulsa

A short meeting was held, January 8, to discuss plans for the I.A.S. Branch picnic at Mohawk Park, January 24. Because of approaching examinations no technical sessions had been planned.

University of Washington

At the meeting on January 9, Chairman Ray Oliver introduced the new officers elected at the last meeting. He explained the general plan of activities of the group for the coming year. The activities to be carried out were based on the results of a poll taken among the members. Committee chairmen in charge of the various activities were introduced and, in turn, explained the functions of the committees. Present committees include those for meetings and papers, employment opportunities and records, membership, and publicity.

Bud Scroggs, former Chief of Structures, Ryan Aeronautical Company, discussed landing gear design.

Wayne University

At a meeting, January 10, A. E. Roach and R. O. Darling, Research Laboratories Division, General Motors Corporation, presented a paper in two parts—"Some Aspects of Aircraft Engine Design." The first section of the paper, dealing with the fundamentals of fuels, was given by Mr. Roach. He compared the Liberty 12-A engine with the Allison V-17P with regard to fuel systems. Mr. Darling discussed fuels and engine design.

News of Members

John C. Adams, Rear Adm., U.S. Navy, Medical Corps, has been transferred to Headquarters, Fifth Naval District, Norfolk, Va., as District Medical Officer.

William R. Anderson, formerly engaged as a Designer and Tool Engineer at Hupp Motor Car Company, is now Chief Engineer at the Pioneer Toledo Corporation.

William H. Beardslee is Sales Engineer for the Burklyn Company. He was previously affiliated with Aerojet Engineering Corporation in Design and Sales Engineering work.

Remus N. Bretoi has recently become a Research Laboratory Analyst at North American Aviation, Inc.

Donald A. Buell is an Apprentice Mechanic in the Plane Overhaul Section at United Air Lines, Inc.

William Z. Bugielski, prior to Army service a Junior Engineer at Eastern Aircraft Division of General Motors Corporation, is now a Vibrations Engineer, Bell Aircraft Corporation.

Edward S. Carter, Jr., before his present position as Structural Engineer, Sikorsky Aircraft Division, United Aircraft Corporation, served in the U.S.N.R.

Joseph V. Charyk, former Research Engineer, is now Assistant Professor of Aeronautical Engineering at Princeton University.

Russell H. Cole has resigned his position as Design Engineer, Aviation Gas Turbine Division, Westinghouse Electric Corporation, and is now Development Engineer in the Power Plant Division, Menasco Manufacturing Company in California.

Thomas F. Coleman, former U.S. Army Air Forces Lieutenant, is engaged as Research Laboratory Analyst, Aerophysics Laboratory, North American Aviation, Inc.

Emerson W. Conlon, who served as a Lieutenant Commander in the U.S.N.R., is Professor and Chairman of the Department of Aeronautical Engineering, University of Michigan.

John C. Cooper, former Vice-President and Director of Pan American Airways, is currently engaged in research work at the Institute for Advanced Study.

Richard J. Crane, until recently a U.S. Army Air Forces test pilot and Operations Officer, is now a Field Representative, Office of Aircraft Disposal, War Assets Administration.

John C. Crown, former Junior Aeronautical Engineer, is now an Aeronautical Engineer, Theoretical Aeronautics Section, Ames Aeronautical Laboratory, N.A.C.A.

Albert C. Davidson, at present affiliated with the Design Engineering Department, Boeing Aircraft Company, Seattle, was formerly connected with the Wichita Division of Boeing Airplane Company.

Albert B. Deyarmond, has recently been named Chief of Structures, Ryan Aeronautical Company, following service in the Army Air Forces as a Lieutenant Colonel. Before the war he was Chief of the Stress Department, Consolidated Vultee Aircraft Corporation.

Fred H. Dietrich, former U. S. Air Forces Captain, is now an Engineer in the Mechanical Equipment Unit, Boeing Aircraft Company.

James R. Downey has been advanced from his position of Chief Engineer and Purchasing Agent, Airport Supply Corporation, to Vice-President in charge of operations. He has also been appointed a Member of the Board of Directors. Mr. Downey joined the staff of Airport Supply Corporation in 1946 as Procurement Director.

Reginald H. Downing, Professor of Mathematics, A.A.F. Institute of Technology, Air Matériel Command, was previously an Engineering Mathematician, Engineering Department, Fleetwings, Inc.

Theodore E. Durmont is now a Project Engineer, Aircraft Engineering, C.A.A. He was formerly on active military duty at the Matériel Command, U.S. Army Air Forces.

John Eyberse, Ground School Instructor of the Eastern Connecticut Airways, was formerly affiliated with the Maintenance Division of the Oklahoma City Air Technical Service Command as a Property Officer.

Donald P. Frankel, previously with the Allison Division of General Motors as West Coast Supervisor of Customer Engineering Service, has recently joined the Power Plant Engineering Section of the Douglas Aircraft Company, Inc., Santa Monica, Calif.

Halton H. Friend, Assistant to the President, Arnold Engineering Company, Chicago, was formerly associated with the Electronic Trainer Department of Curtiss-Wright Corporation, Caldwell, N.J.

George M. Fuller, an Aerodynamicist at Boeing Aircraft Company, was previously affiliated with Lockheed Aircraft Corporation.

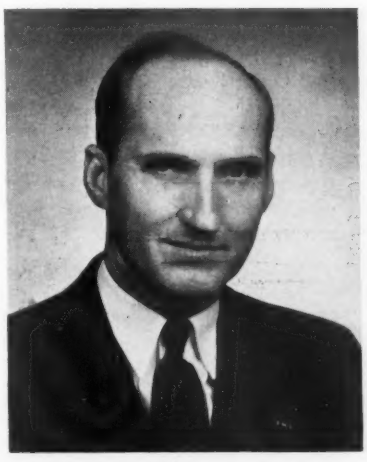
Frank W. Furry, Aerodynamics Engineer, Pacific Division, Bendix Aviation Corporation, was formerly a Layout Draftsman and Structures Engineer at North American Aviation, Inc.

George W. Gewinner is now a Draftsman at Pratt & Whitney Aircraft Division, United Aircraft Corporation.

Charles J. Gilbert, Jr., prior to his present position as Flight Test Engineer, Chance Vought Aircraft Division, United Aircraft Corporation, was a Lieutenant in the U.S. Army Air Corps Engineers.

Roswell W. Gilbert is engaged as Research Director of Weston Electrical Instrument Corporation. He was formerly Director of the Rockaway Valley Laboratory.

A. W. Gilmore has been appointed Manager of a new General Electric Wire and Cable Division. The new division is a consolidation of the former Wire and Cable Division at Bridgeport, Conn., and York, Pa. Mr. Gilmore worked with the B-R Electric Company, as Kansas City distributor, before joining the General Electric organization in 1926. After a period as salesman, then sales manager, for the General Electric Supply Corporation, Kansas City, he was appointed District Manager for that company in 1938. Following 3 years' service as a Lieutenant Colonel with the supply and service department of the Air Transport Command in Europe, Mr. Gilmore came to Bridgeport as assistant to the General Sales Manager of the G-E Appliance & Merchandise Department. In his new position he is responsible for engineering, manufacture, and sales of the Wire and Cable Division.



A. W. Gilmore.

Charles C. Greene, Lt. Col., U.S. Army Air Reserve, has been elected Historian of the New York regional chapter of the Air Reserve Association.

Andrew F. Haiduck, former Vice-President in charge of engineering at Bellanca Aircraft Corporation, is now General Manager of the Duramold Division, Fairchild Engine and Airplane Corporation.

Najeeb E. Halaby, Division Chief, State Department, Washington, D.C., was previously Assistant Flight Test Officer of the U.S.N.R. Flight Test Section.

Charles F. Hartel, Jr., has resumed his position as Research Analyst at Consolidated Vultee Aircraft Corporation following a tour of active duty in the U.S. Navy.

Adrian L. Henneberger is now a Draftsman at White Construction Company.

Donald E. Hewes, former Engineer at the Engineering Research Corporation, is now a Research Aeronautical Engineer, Langley Memorial Aeronautical Laboratory, N.A.C.A.

Leonard S. Hinder has returned to Republic Aviation Corporation as a Research Engineer after active service in the U.S Navy.

William H. Horn, Engineer, is now connected with the Aircraft Wheel & Brake Section of United States Rubber Company. Mr. Horn was previously Project Engineer, Stout Research Division, Consolidated Vultee Aircraft Corporation.

Herbert B. Hubbard is engaged as an Aeronautical Engineer for United Air Lines, Inc.

Kenneth M. Hughes, former Junior Aeronautical Engineer, Ames Aeronautical Laboratory, N.A.C.A., is an Aerodynamicist at Hughes Aircraft Company.

Herbert E. Jacques has joined the Aerodynamics Department, Chance Vought Aircraft Division, United Aircraft Corporation.

Ralph W. Johnson is connected with Kellett Aircraft Corporation as a Stress Analyst. He was previously in the Sikorsky Aircraft Division, United Aircraft Corporation.

Roscoe H. Johnson, Jr., former Lieutenant Colonel in the U.S. Army Air Forces, Regional Safety Officer, is an Aeronautical Inspector for the C.A.A.

Theodore R. Just, formerly a Stress Analyst at Santa Monica Division of Douglas Aircraft Company, Inc., is now a Designer in the Fuselage Group, Structures Section, El Segundo Division of the same company.

Abraham Kahane is a Research Associate at Princeton University Aeronautical Laboratory. He was previously a Junior Aeronautical Engineer at the Langley Memorial Aeronautical Laboratory, N.A.C.A.

Carlton Kemper has been transferred to the Aircraft Engine Research Laboratory, N.A.C.A., as Executive Engineer. He was previously Chief of the Power Plants Division.

Edward L. Koenig has returned to United Aircraft Corporation as a Service Liaison Engineer in the Chance Vought Aircraft Division. Prior to Army service he was a Junior Designer.

Eryk Kosko has joined A. V. Roe Canada Limited as a Senior Stress Analyst. Prior to this position he was Chief Stressman at Fairchild Aircraft Limited in Canada.

Valerien P. Kousnetzoff has recently joined the Bureau of Aeronautics, Navy Department. He was previously affiliated with the Curtiss-Wright Airplane Division.

Col. G. deFreest Larner has been elected a Director of the H. K. Porter Company, Inc. He has been Assistant to the President for several years, supervising operations and coordinating activities of the Porter organization. Colonel Larner has recently returned from the Kinderliter Tool Company, Tulsa, Okla.

August A. Lenert, Jr., is now an Aeronautical Engineer, Climatic Hangar, Army Air Forces Proving Ground Command, Florida.

Wallace A. Lien has joined North American Aviation, Inc., as an Engineering Test Pilot.

Thomas P. Lombardo, former Project Engineer, Taca Airways, Inc., is now Chief Engineer at Pioneer Air Lines, Inc.

Arthur L. Lowell is now affiliated with McDonnell Aircraft Corporation as a Design Engineer.

Stanley H. Lowy has joined the Allison Division of General Motors Corporation as Engineer.

Frank E. MacKnight has returned to Firestone Aircraft Company as Sales Engineer. Before the war he was engaged in Design Engineering.

Walter K. Marschner, former Chief Draftsman, G. & A Aircraft, Inc., is now a Project Engineer at RotaWings, Inc.

Elmer L. McCall is a Junior Designer of Mill Machinery, Mesta Machine Company.

Kenneth G. Merriam has returned to his position of Professor of Aeromechanics at Worcester Polytechnic Institute. He served for 4 years in the Army and now holds a reserve commission as Colonel. During the war Colonel Merriam was active in helping to bring the radio-controlled airplane targets into effective use by the automatic weapons component of the antiaircraft artillery. Later, he was Director of the Fire Control Department of the Antiaircraft Artillery School at Fort Bliss, Tex. A section of this department was the A.A.'s first instruction unit in Guided Missiles. Colonel Merriam was awarded the Legion of Merit and the Army Commendation Ribbon.

Carlton Kemper.

Vladimir Morkovin has joined the faculty of the University of Michigan as an Assistant Professor in the Department of Aeronautical Engineering. Mr. Morkovin was previously engaged as Research Aerodynamicist at Bell Aircraft Corporation.

George W. Myron, an Instructor at the Academy of Aeronautics before the war, is now a Design Engineer at Boeing Aircraft Company.

Stanford E. Neice, former Junior Engineer, N.A.C.A., and, later, a Weather Officer and Forecaster, U.S. Army Air Forces, is now an Engineer in the Gas Dynamics Section, Langley Memorial Aeronautical Laboratory, N.A.C.A.

Robert L. Nelson is now an Aeronautical Engineer at the Langley Memorial Aeronautical Laboratory, N.A.C.A.

John W. Oehrli, prior to his present position as Consulting Engineer, Salsbury Motors, was Engineer in Charge of Design and Development, McCulloch Aviation.

William S. Patterson has joined The Glenn L. Martin Company as Stress Analyst. He was formerly affiliated with Douglas Aircraft Company, Inc.

Col. G. deFreest Larner.

Felix W. Pawlowski, Professor Emeritus of Aeronautical Engineering, University of Michigan, and Consultant at Douglas Aircraft Company, Inc., Santa Monica, Calif., resigned in February, 1947, and is now living at 3 Rue du Midi, Pau, Basses-Pyrenees, France.

Felix A. Perry, following his tour of active duty in the U.S. Navy, has returned to Northwest Airlines, Inc., as Aircraft Project Engineer.

Fletcher N. Platt, formerly affiliated with Kaiser Fleetwings, Inc., is now Chief Design Engineer, Research Division, Rheem Manufacturing Company.

John W. Rane, Jr., is now a Sales Engineer at Bell Aircraft Corporation.

George C. Roberts is now Assistant Director of the Department of Aeronautics, Springfield, Ill. He was formerly Secretary of the Illinois Aeronautics Commission.

Laurance S. Rockefeller has been elected a Member of the Board of the International Nickel Company of Canada, Ltd.

Donald B. Ross is now an Engineer at American Airlines System.

Earl P. Rothgeb, previously a Liaison Engineer, Modification Center, Douglas Aircraft Company, Inc., is now Chief Mechanic at Pan American-Grace Airways in South America.

Norbert E. Rowe has joined British European Airways in England as Controller of Research & Long Term Development. He was formerly Director of Technical Development, Ministry of Aircraft Production.

James D. Ryan is now Chief Engineer at Ryan Manufacturing Company.

William F. Savage is an Instructor of Aeronautical Engineering at the University of Kentucky. He was previously an Aerodynamicist at Consolidated Vultee Aircraft Corporation.

David Shearston is Civilian Supervisor in charge of Armament Installation Design, Naval Aircraft Modification Unit. Prior to this position he was Test Engineer at Fleetwings Division of Kaiser Cargo, Inc.

Igor I. Sikorsky was presented the Frank M. Hawks Memorial Trophy in recognition of his development of the helicopter. The ceremony took place at a dinner of Air Service Post 501, American Legion, at the Wings Club, Hotel Biltmore, New York, January 28.

Joseph M. Sorensen has returned to Northwest Airlines, Inc., following his tour of duty as Radar Maintenance Technician in the U.S. Naval Air Station, Boca Chica Field. His present position is Aircraft Electrical Engineer.

Louis J. Stary is now engaged as Engineer in the Interiors Section, DC-6 Sleeper planes, at the Santa Monica Division of Douglas Aircraft Company, Inc.

Charles E. Stilson is now Senior Research Physicist at Fredric Flader, Inc. Prior to this position he was Physicist at Cornell Aeronautical Laboratory.

Joseph Stuart, III, has joined the engineering staff of United Helicopters, Inc., Palo Alto, Calif. Mr. Stuart for the past

4 years has conducted helicopter design studies, analysis, and supervision for the Aero Products Division of General Motors Corporation. He was sent to Europe just prior to VE Day to assist in the Army Air Forces Technical Intelligence activities, including investigation of all German helicopters.

Richard U. Surbeck, former Assistant to the President of Aviation Equipment & Export, Inc., is now Vice-President of Aviquipo, Inc.

John R. Sutton, Electrical Engineer, is now connected with Curtiss-Wright Corporation, Columbus, Ohio.

Richard W. Swanson, 1st Lt., U.S. Army Air Forces, has been promoted to Wing Staff Radar Officer.

George Tankersley is connected with the United Aircraft Corporation as Experimental Test Engineer of the Pratt & Whitney Aircraft Division, United Aircraft Corporation.

Robert C. Tetens is Assistant Stress Analyst, McDonnell Aircraft Corporation.

George Tharratt has joined Douglas Aircraft Company, Inc., as a Preliminary Designer. His extensive engineering background includes the recent positions: Chief Engineer, Adel Precision Products Corporation; Manager West Coast Division, Lear-Avia, Inc.; and General Manager, California Division, Lear, Inc.

William W. Thomson, recent Experimental and Development Engineer for Wilson-Zuck Aircraft Company, is now Liaison Engineer at The Glenn L. Martin Company.

Thomas H. Townsend, Jr., is engaged as Stress Engineer at North American Aviation, Inc.

George H. Tweney resigned his position as Director of the Department of Aeronautical Engineering at the University of

George Tharratt.

Detroit on October 1. Since that time he has been engaged in consulting work as a Registered Professional Engineer in the State of Michigan. On January 20 he became associated with Wayne University in Detroit as Professor of Aeronautical Engineering.

Harold J. Varhanik, Design Engineer, has transferred from Lockheed Aircraft Corporation to Beech Aircraft Corporation.

Frederick C. Waite, Jr., has become Chief Engineer, Flight Section, Special Devices Center, Office of Naval Research.

John Wessale, former Aerodynamicist at North American Aviation, Inc., is now a Pilot-Engineer at Cessna Aircraft Company.

Robert O. Wickersham, former Professor and Head of Aeronautical Engineering, West Virginia University, is affiliated with the Guided Missile Section, Engineering Division, U.S. Army Air Forces, Wright Field, Ohio.

B. Furman Wilkes is now a Junior Research Engineer at Shell Development Company.

Oswald Williams, Jr., is now a Senior Aerodynamicist at Republic Aviation Corporation specializing in jet power plants.

Herbert T. Woods, Jr., is a Research Analyst at Consolidated Vultee Aircraft Corporation. Before his service in the Army Air Forces he was an Engineering Assistant at Lockheed Aircraft Corporation.

Arthur W. Woodward has joined the Columbus Plant of Curtiss-Wright Corporation as a Design Engineer. He was previously a Junior Aeronautical Engineer at the Aircraft Engine Research Laboratory, N.A.C.A.

Robert L. Zouck has recently joined The Glenn L. Martin Company as a Layout Designer.

Irving Zuckerman has been promoted from Junior Stress Analyst to Test Engineer at The Glenn L. Martin Company.

MEMBERS ELECTED

Because of space limitations, the columns of Members Elected have been omitted this month.. The names of all newly elected members and transfers during the two-month period will appear in the April Review.

I.A.S. National Meeting Schedule

Aircraft Propulsion Meeting—Cleveland, Ohio, Carter Hotel—March 28, 1947

Personal Aircraft Meeting—Detroit, Mich., Horace H. Rackham Educational Memorial—May 26–27, 1947

Annual Summer Meeting—Los Angeles, Calif.—August 7–8, 1947

All correspondence should be addressed to The Meetings Committee, Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.

Honors Night Dinner

Hotel Astor, New York

January 27, 1947

If one picture is worth 10,000 words, this is one of the longest editorials ever to appear in the *Review*. It does say many things. It says that here is an organization that is *of*, *for*, and *by* the aeronautical engineer—an organization whose past activities and future programs command the enthusiastic support of the industry it proudly serves. With the backing of its individual and industrial members, as evidenced at the recent Annual Meeting (of which the Honors Night Dinner was the "take-off"), the Institute embarks with confidence on its fifteenth year of service to the Aeronautical Sciences.

Editorial

The Hon. W. Averell Harriman (*right*), with James H. Doolittle (*left*) and the Hon. W. A. M. Burden, at the Guest of Honor Reception.

DINNER GUEST SPEAKER

The Honorable

W. Averell Harriman

Secretary of Commerce

on

Civil Aviation—

"FIRST, I WANT TO MAKE IT CLEAR that I share with you all an implicit faith in the present and the future of aviation. Aside from my vital interest in aviation as a part of my official responsibilities, I am an enthusiastic advocate of it for personal and business uses.....

"In the years following the first world war, the increase in the speed and precision of railroad freight deliveries had a revolutionary effect on the size of stocks which manufacturers and distributors had to maintain. Air shipments of special or emergency freight will make an additional contribution to the efficient functioning of the nation's assembly lines and distribution system.

"Also in international relations, both commercial and political, the speed of air travel has proved of paramount importance. In fact, aviation is not merely an important convenience to international relations—it has become an absolute necessity without which the United Nations itself could hardly function.

"In our efforts to accelerate aviation progress there are a number of things we can learn from the record of the development of other forms of transportation."

The first hurdles of the automobile industry were: (1) the obtaining of public acceptance of their new, and annoying product and (2) the provision of sufficient roads and services to enable the automobile to be generally usable. But "the public had to *accept* the automobile—understand its values, its requirements, and its limitations *before* it would support the construction of roads.

"The public has already an enthusiasm and understanding of the values of aviation, yet confusion has resulted because there is not yet a thorough understanding of its limitations and requirements..... After having known or heard of the progress during the war, and after being led to think in terms of giant, all-weather aircraft, with de luxe ground facilities and services, the beginner air passenger is shocked to discover that we have not yet reached the forecast condition. Others who do not ride, but who are potential converts, learn of delays at terminals, of canceled flights, and particularly of the accidents, and they lose some of their benevolent interest. With frequent headlines about air disasters in every part of the globe, the fact that the mileage of scheduled air lines has gone up while the accident rate had declined substantially does not register.

"The aftermath of disillusionment has been a decline in air-line patronage, and it is also reflected, I understand, on the order books of manufacturers of even private planes..... But the present situation can be turned into an asset if all concerned will knuckle down to do the various things that must be done to regain loss in prestige and to prepare for the real opportunities ahead..... We must improve existing facilities

* Excerpts from the complete address.

and services. We must develop additional airways, airport facilities, and new methods of control.

"We must continue our efforts to make possible consistent all-weather operation of private and commercial aircraft. We must give concentrated attention to all the human and technical factors which will accelerate the record of increased safety which has been made in the past. . . . .

"In spite of the attention that flying accidents have attracted recently, the record for improvement has been impressive. It is now much safer to fly on scheduled air lines than it was on the average in the years before the war, and in 1946 the fatality rate was 40 per cent less than for 1945. Last year these air lines flew over 80,000,000 passenger-miles for each passenger killed in an accident, a distance equal to nearly 15,000 round trips across this continent by a single passenger.

"Still. . . . we have a long way to go to make the air safety record compare favorably with the safety record of other common carriers—the railroads and the bus lines. . . . . The fight for safety is the kind of tough fight in which this country excels. The same principles which brought success in other fields will bring success in aviation. I have full faith that the record of air safety can, in the not too distant future, equal the present fine record of the railroads and the busses. The questions we face are simply how long will it take and how can we best hurry it along.

"In the field of airway aids. . . . we must have equipment installed on the airways which will enable us to operate regularly and safely at minimums substantially below those in force today. We must devise a method for expanding the capacity of the airways *between* terminals as well as *at* the terminals. We must find ways and means of developing for our airways an automatic control system similar in purpose to the systems in use on all railroads. And we must aggressively pursue a development program aimed at truly safe all-weather flying for everyone, the commercial operator, and the private flier.

"In contrast to its effect on most phases of aviation, the war seriously delayed the modernization of our airways system. . . . . Military requirements made it impossible to obtain the material for the program. . . . ." That imposed "an unavoidable three-year delay—time which now must be made up.

"On the other hand, the war did make a great contribution in the development of air-navigation facilities based on radar equipment which, when properly adapted to commercial use, will help materially in making flying safer and easier. . . . .

"The conversion of the radio ranges to V.H.F., slowed by the war and by delays in material deliveries, should be completed over the entire system of airways by the middle of 1949. . . . . The I.L.S. (glide path and localizer instrument landing system), now in actual operation at 31 airports, will be installed at 100 airports by next summer, and we hope for an additional 55 next year. . . . .

"It appears that the G.C.A. (Ground Controlled Approach) radar talkdown system can also perform a most useful function at many airports where traffic is heavy enough to justify the very considerable expense of installation and operation. Three new type G.C.A. sets on loan from the army will be in operation before the winter is over for service tests at New York, Chicago, and Washington. It is expected that recommendations will be made for operation and ultimate purchase of 20 more which the army has just informed us they can make available on loan. . . . .

"The cost of the whole program, while large, is very small in terms of our essential expenditures on military aviation. . . . . From 1921 to 1940, the Federal Government alone has spent approximately $6,500,000,000 on the highways, and state and local governments, an additional $35,000,000,000, which made possible the universal use of automobiles. In all of the years up to 1945, the Federal Government spent about $800,000,000 in promoting civil aviation. . . . .

"An essential condition to progress in aviation is the financial health of the industry, both in air-lines operations and in manufacturing. We all know that here again there has been some undue optimism. . . . . I mention it as having an all-important bearing upon our ability to seize the opportunities before us and to achieve the results that the public has a right to expect.

"In 1945, the C.A.A. made an estimate of progress and opportunities to be expected in civil aviation for the following 10 years. Although a deliberate effort was made to be conservative in the forecast, the picture looked very good. In 1946, however, the performance, in passenger-miles, exceeded the forecast and was almost half of the estimate for 1955 (13,200,000,000). That is a stimulating achievement which gives rise to hopes that we hardly dare express—but should spur all of us to greater efforts.

"To attain our common objectives, all of us must work together. There is need for aggressive leadership in Government and in industry. I am fully conscious of the great responsibility and the opportunity of the Department of Commerce. I personally intend to give to the problem my earnest attention. I ask you of the industry to give us continued support and cooperation."

a new economic frontier—

ARMY AVIATION

Excerpts from Army Day Luncheon Address

by

MAJOR GEN. L. C. CRAIGIE

"The Army Air Forces Development Program"

★ ★

"THERE IS NO DOUBT of our agreement on the need for a comprehensive and cooperative program for national defense..... Scientific research, industrial preparedness, and military planning are inextricably tied together in the attainment of our national security.....

"In the technical field, we are still very much concerned with the problems inherent in subsonic flight, since we have not attained the ultimate in subsonic aircraft. There is still a vital need for such aircraft, particularly in the light of plans now under way to make the entire Army totally air transportable and airborne.....

"There is much left to be done in the subsonic sphere, but our major problems today are those posed by the advent of the supersonic guided missile and the necessity for our crashing the wall of transonic speed for accomplishing flight in the supersonic range.....

"The recent gratifying performance of the XS-1 rocket-propelled plane on its first powered test flights above our proving base at Muroc, Calif., has provided us with the first of a series of experimental crowbars with which we hope to jimmy our way through the transonic barrier. It is a research tool.....

"There is today a compelling need for a comprehensive and aggressive upper air research program..... Accordingly, we have initiated an intensive investigation along these lines, and this program is being given high priority in relation to other existing research projects.....

".....Man is not built to absorb the terrific accelerations and punishing decelerations which we contemplate encountering in supersonic flight..... Therefore, we are conducting exhaustive tests to determine man's limitations with the objective of providing means to overcome them.....

"Power plants to propel us through the transonic and supersonic ranges are a problem, particularly from the fuel economy standpoint.....

"So far as aircraft structures are concerned, the chief problems have to do with wing and control design, nacelle installations, materials, and escape provisions.....

"Our plans and program rest upon such funds as the Congress deems ample for the purpose. The annual appropriation, measured by prewar standards, will have to be exceedingly generous.....

"Industry must be in a continuous position to absorb the results of scientific research and apply this to military development.....

".....A vigilant industrial and military preparedness requires that the armed services be kept continuously provided with test quantities of equipment large enough to permit simulated defense maneuvers on a reasonably large scale.....

".....It is our considered judgment that the peacetime program of the Army Air Forces call for an annual procurement of at least 3,000 military aircraft.

".....There is a very real need for a whole new set of development or test facilities.

"A study of these requirements has resulted in the proposal to build an Air Engineering Development Center.....

"In the matter of qualified man power, this country is fairly fortunate. No nation in the world has greater potential for the development of scientists and engineers.....

"The full significance of our efforts must not be allowed to sink into a peacetime lethargy. At this stage of the game the military cannot take off to live in a world of its own. Reinforced by the faith of the people, we of the Armed Forces and you of science and industry can go forward in the preservation of peace through power. The knowing minds which make up the Institute of the Aeronautical Sciences can do much to rouse the American people to the lasting realization that they can place their trust in us in peace as they did in war."

CIVIL AVIATION

Excerpts from Civil Aviation Day Luncheon Address

by

THE HON. W. A. M. BURDEN

"The Engineer's Part in the Civil Aviation Expansion Program"

★ ★

"AT A PERIOD LIKE THE PRESENT when aviation is having its temporary difficulties the requests for the impossible are once more pouring in..... I am going to add to the list by devoting this talk to some of the improvements which we feel are badly needed in personal aircraft.....

"Perhaps this is a good time to re-examine the fundamental requirements which personal air transportation must meet if it is to develop a large market. All agree that these requirements are summed up in the one word, 'utility.' Breaking that word utility down, we find that the personal aircraft must: (1) enable the owner to get from his point of origin to his point of destination substantially faster than surface transport; (2) do so at a reasonable cost; (3) be capable of safe use in reasonably bad weather as well as good—in other words, be reliable; (4) be fairly easy to learn to fly.

".....What we would like to see is a four-place 125–130-m.p.h. airplane selling for $3,500, and so far we have not got it. And when we get into the low-price airplanes we find that many of them still have cruising speeds of only 90–95 m.p.h.—little if any faster than they were before the war.

"So I hereby enter a plea to the engineers for at least 30 per cent more speed in the low-cost airplane without making it more difficult to fly.

"Another, and even more important, way in which the effective door-to-door speed of the conventional airplane could be greatly increased on short trips would be by design developments which would enable it to use a single landing strip regardless of wind direction.....

"Another and even more intriguing possibility of effective timesaving over relatively short distances lies in the unconventional aircraft and particularly the helicopter, which in effect removes the need for expensive landing facilities of large areas and thus vastly increases the potential utility of personal flying.....

".....There is nothing which will contribute to safety more than the ability to slow down when the visibility gets poor.

"Now we come to another very important factor in utility—first cost..... A good deal can probably be accomplished by designing the aircraft from the beginning for low-cost production—but the real answer to reducing costs is increased production and the only way to increase production is to increase utility. So the burden in the end is thrown on the men who design the airplanes rather than the production engineers.....

".....Immediate improvements which deserve attention and will not require too much intensive development include such matters as simplicity of engine and other controls.....

"Lower maintenance costs are certainly desirable. Here, ultimately, perhaps, the simplicity of the gas turbine driving a propeller as compared to reciprocating engine may have a contribution to make.....

"The real answer to increased personal aircraft sales is an improved product and the real answer to an improved product is increased research and development.....

"I can see nothing restrictive or unsound in making federal funds available for development contracts with emphasis on new and radical types of personal aircraft—fixed-wing and rotor.

"Admittedly, it will be extremely difficult to obtain substantial funds for such a purpose under present budgetary conditions. It will be *impossible* to obtain them without united industry support.....

"I believe that at this critical point in the development of the personal plane industry we should hold a conference of the chief engineers of the personal plane and helicopter manufacturers, the C.A.A., and the N.A.C.A., and the Army and Navy engineers interested in this field for the purpose of evaluating the present state and future outlook for all existing research and development programs"

Impressions of the Annual Meeting of the Institute

ALEXANDER KLEMIN
Aeronautical Consultant

SINCE ABSTRACTS OF ALL PAPERS delivered appear elsewhere in the AERONAUTICAL ENGINEERING REVIEW and, since speeches of distinguished guests are also fully reported, I do not propose this year to write a systematic review of the Annual Meeting. I propose rather to set down, informally, those developments, trends, analyses, or predictions which appeared to me most significant. It has been found impossible to review five or six valuable papers.

First, some overall impressions. For the first time, breaking with tradition, the meeting was held at a New York City mid-town hotel instead of at Columbia University. This arrangement appears more logical and convenient in every possible way. Another impression: what a change in the men who read papers and discussed them! The war took a great toll of the old timers. Some grew tired, some died, some were "kicked down" to executive positions. In applied science, just as in boxing, youth will tell, and the papers were all the better because they were read by younger men. One sad observation: engineers, at meetings, still torture their hearers. A man spends 6 months writing a wonderful paper. Then he hurriedly presents a string of incomprehensible equations on the blackboard or reads his paper at full speed for a half-hour. In either case the audience is miserable, the discussion perfunctory. Engineers should write two papers—one for publication, which may be as profound and analytical as they wish; the other for oral presentation, which should be simple and nonmathematical, and should present the main points of the investigation as strikingly as possible.

Aerodynamics Means Supersonics

Classical aerodynamics of definitely subsonic flow must yield the place of honor and, rightly so, to transonics and supersonics. In the two Aerodynamics Sessions, four, perhaps five, papers were concerned with this new and adventurous field.

Modern aerodynamics shows far wider scope, a bolder grasp of the problem of supersonic flow once thought insoluble, and, in the skilled use of modern and advanced mathematical methods, the passing of the torch to younger men. At times the mathematical approach is overwhelming. This approach is a legacy of the war effort when large numbers of mathematically trained, brilliant young men were brought into the picture. Is it impudence to remind such able men that great workers such as Lord, Rayleigh, Prandtl, and von Kármán always retained their grasp of physical reality, wrote extremely simple papers, and were not afraid of nonmathematical exposition?

Alexander Klemin.

But, I hasten to add, the papers were excellent, valuable, and productive of new ideas.

For example, H. F. Ludloff (New York University) in his paper "Linearized Treatment of Supersonic Flow Through and Around Ducted Bodies" gave engineers of the turbojet power plant a new weapon for the designing of ducts in extremely high-speed flight. The conical shock wave originating at the mouth of the duct and the associated discontinuities can increase drag and destroy the "reversibility of the diffuser." Professor Ludloff applied the method of distributed "sources and sinks" first applied by von Kármán and Moore to the study of the internal flow, the effect of the front rim of the duct, etc., and also discussed the supersonic drag.

E. V. Laitone (Cornell Aeronautical Laboratory) in "The Subsonic and Supersonic Flow About Slender Bodies" has really carried the subject a good deal further and has removed serious uncertainties that have hitherto existed in the linearized flow equations at high Mach Numbers. Mr. Laitone aptly summarizes his extensive research: "It is shown that previous solutions of the linearized supersonic flow equations have retained terms which were incompatible with the basic

William R. Sears, Chairman, Aerodynamics Session, Part I.

potential equation of compressible flow. Extremely simple relations are developed for the lift and moment of bodies of revolution in inclined subsonic and supersonic flow. These relations are shown to be in very good agreement with experimental measurements. It is shown that the commonly used linearized solution for the supersonic flow about an inclined body of revolution is incorrect since nearly all of the terms retained are of a higher order than the terms omitted in neglecting the effect of the velocity component due to axial flow." There is also welcome news for designers of transonic and supersonic aircraft. "Expressions are also presented for computing the two-dimensional subsonic and supersonic flow about sharp nose airfoils. The computed surface pressures are shown to be in excellent agreement with experimental measurements on typical wedge and biconvex airfoils."

Transonic aerodynamics is difficult. Flutter is complex. The combination "Oscillating Air Forces and Flutter at Supersonic Speeds (Two-Dimensional Case)" by I. E. Garrick (N.A.C.A.) is awe inspiring. Of course, Mr. Garrick does simplify the theoretical analysis by restricting the flow to irrotational flow, and to small perturbations from the mean flow. But these restrictions are made in stability and are legitimate, and the paper is not too complex. The theory has its starting point in Possio's memoir *L'azione aerodinimica sul profile oscillante alle velocita ultra sonore.* It arrives at some important conclusions. The flutter problem still exists in the supersonic range but for more restricted ranges of the parameters. The technically important range for determination of flutter-free designs is near Mach Numbers around unity. Hence, attention should be focused on the transonic region, precisely one it is difficult to investigate. Although the theory leads to new territory, the safeguards against flutter sound familiar. "High torsional stiffness and forward locations of the center of gravity are the most important technical safeguards." Mr. Garrick plots flutter speed against Mach Number and makes brief mention of wing divergence, aileron reversal, and a one-degree-of-freedom oscillatory instability in torsion.

"Aerodynamic Performance of Delta Wings" by H. J. Stewart and A. E. Puckett (California Institute of Technology) does not use the word transonic or supersonic in the title but delta wings have their application solely in these regions. It extends theory of drag, lift, centers of pressure for swept-back and swept-forward wings. The authors also discuss optimum design from the standpoint of loading and trailing-edge angles and location of maximum thickness. Considerable improvement over two-dimensional airfoil performance can be obtained. The paper will be studied widely.

The paper by Glenn H. Peebles (Douglas) on "A Method for Calculating Airfoil Sections from Specifications on the Pressure Distributions" is an excellent example of the modern mathematical methods that have come into the design room. Dr. Peebles, by using the principles of conformal transformation of a circle into a plane, in a highly original manner can construct a profile that will have a pressure distribution that has been almost arbitrarily specified. If the pressure distribution is the one desired, then the pressure gradient is also the one desired. With the pressure gradient under his command, the aerodynamicist can secure a wing profile that will have good laminar flow characteristics at low lift, and be suitable for high speeds; or make the gradients gentle enough at the nose to avoid laminar separation at high lift.

Turbulence and the Bureau of Standards

Two papers relating to turbulence were presented under the auspices of the Bureau of Standards, Aerodynamics Section. Not too striking in themselves, they deserve especial attention as a fine example of research policy. For years the Bureau of Standards, with full encouragement of the N.A.C.A., has gone deeply into the question of turbulence, its effect on tunnel design, on the transition point, on boundary layer, etc. It has kept steadily to an unspectacular but important field and its research workers have gained mastery in and steadily advanced this field. Only in the early aerodynamic research of the National Physics Laboratory do we see true scientists at work with the same steadfastness of purpose, the same disregard of immediate applause. Typical of this continued policy was one paper by G. B. Schubauer and H. K. Skramstad, "Laminar Boundary-Layer Oscillations and Stability of Laminar Flow." This gives an experimental account of the velocity fluctuations in the boundary layer, confirms the Tollmien-Schlichting stability theory, and throws new light on the cause of transition from laminar to turbulent flow. It is not necessary to repeat how important such transition is in the design of airfoils, the reduction of skin friction, etc. The other paper in a closely related field, by Hugh L. Dryden and G. B. Schubauer, "The Use of Damping Screens for the Reduction of Wind-Tunnel Turbulence," illustrates another point in the development of a science or of a

branch of technology. It is possible even for scientists to follow a fashion and for the fashion to be wrong. Thus Dr. Dryden and Dr. Schubauer point out that a number of years ago designers of wind tunnels sought to increase the effective Reynolds Number of the channel by introducing rough screens and increasing the turbulence. Perhaps they were right, for the moment, because experiments at a larger Reynolds Number were desperately needed at the time. That they were wrong in the long run means the atmosphere is almost clear of "turbulence" in the specialized aerodynamic sense. Dr. Dryden and Dr. Schubauer are now right to seek a decrease in turbulence by the use of many fine screens.

Vibration and Flutter

Reinhardt M. Rosenberg (Purdue University) in "Critical Speeds of Shafts under Torque" not only presented a learned paper but found a way of making it immediately intelligible to the audience. We can do no better than quote his own summary:

"In airplane configurations of certain recent designs where the propeller is located aft of the tail surfaces, it is driven by a long drive shaft subjected to high torques.

"A shaft which is subjected to torque has a critical speed different from that of the same shaft not under torque.

"This paper contains an exact analysis of the critical speed of shafts under torque, resulting in a condition on the critical speed, necessary to satisfy exactly the differential equations of the problem. This solution is, in its present state, too laborious to be useful to the engineer. Therefore, an approximate solution, relying on Raleigh's principle of energy equilibrium, is given as well.

"This approximation results in simple expressions for the critical speeds of shafts (or the natural frequency of beams) under torque. It is found that the critical speed of the shaft under torque is always greater than that of the same shaft under zero torque. The cases treated are the shaft between universal joints and the shaft pin-ended in one plane only. The formulas reduce to the familiar expressions for critical speeds when the applied torque equals zero."

Herbert R. Lawrence, Adam T. Zahorski, and William E. Cox, all of Northrop Aircraft, presented a fine study of "The Dynamics of a Swept Wing." Since a swept wing, and particularly a swept-back wing, is so important in transonic and supersonic design, the study of its torsional and other oscillations becomes of prime importance. The authors have provided just the information needed by designers in regard to flutter speed, to the study of back wing swept air line, and the like. An excellent summary forms part of the paper:

"It is assumed that a swept wing may be represented dynamically by a plane curved rod of variable cross section with finite stiffness in torsion and in bending normal to its plane. The equations of motion for this configuration are exhibited with the restriction that the curvature of the elastic axis be finite. By allowing the curvature to become infinite at a point, certain auxiliary conditions are obtained at the bend. The validity of this limiting process is examined from the physical viewpoint. A wing with an elastic axis consisting of a plane broken line of $(n + 1)$ segments is denoted as an "n bend wing." A method is developed for calculating the natural frequencies and modes of a single bend wing. Formulas for the natural frequencies and modes of a free-free symmetric single bend uniform rod are obtained. A generalized type of orthogonality condition between the modes of a single bend wing is proved. Based on these results, formulas are developed for the dynamic response of a single bend wing to a general system of forces. A method of generalizing the above results for a single bend wing to the n bend wing is indicated. The use of an n bend wing as an approximate representation of a wing of continuous curvature is discussed."

In the same session Samuel Levy, National Bureau of Standards, took up the "Computation of Influence Coefficients for Aircraft Structures with Discontinuities and Sweepback." The author's summary reads:

"A general method for computing influence coefficients is outlined which uses Castigliano's theorem together with a stress analysis of the airplane structure based primarily on equilibrium conditions. It is shown, by means of examples, that this method is particularly suited to wings having discontinuities, cutouts, and sweepback. It is also particularly suited to taking account of end fixity at the wing root.

"A method is also presented for use of the influence coefficients in computing, by iteration, the normal modes of vibration of an airplane as a free body in either symmetric or antisymmetric motion. This method avoids the necessity for knowing the location of the elastic axis and gives directly the coupled torsion and bending modes."

Dynamic Stability and Control of Guided Missiles

The analysis of the dynamic stability of the airplane goes far back. It began with Bryan only 5 or 6 years after the Wright Brothers' first flight and has been carried on brilliantly by Bairstow, Thompson, Robert Jones, and many others. It has been understood quite well for a long time but has rarely been put to work in design. Why? Because simple tunnel tests and empirical coefficients based on experience gave satisfactory results and, besides, the dynamic stability analyses were frightfully complicated and the resistance derivatives not readily obtainable. But one cannot be satisfied with these empirical and simple methods when dealing with extremely high speeds and with guided missiles. Now Cornell Aeronautical Laboratory, with the support of Wright Field and the cooperation of Minneapolis-Honeywell, Sperry Gyroscope, etc., has developed an ingenious technique of flying models in which automatic controls give any desired disturbance, the most modern multiple-channel dynamic recording equipment gives complete data, and intelligent analysts interpret and simplify for the benefit of the designer.

Ernest G. Stout, Chairman, Flight Test Session.

William F. Milliken, Jr., who originated the project, in his paper "Progress in Dynamic Stability and Control Research" makes out an excellent case for the indispensability of such methods. The following two sentences alone would convince anyone who is plagued by stability, control, and disturbance in high-speed work: "While a check had been established between the measured response and conventional theory, a far more significant possibility—that of obtaining the derivatives directly from the flight tests—had been opened. Thus, a method for determining these aerodynamic constants at high Mach Numbers, or under other conditions beyond the scope of wind-tunnel data and theory would be extremely worth-while.

There were two excellent companion papers to Mr. Milliken's in the Flight Test Session. One was by Charles E. Hastings, "A Precision Radio Navigation and Tracking System."

In the other paper Harold K. Cheney (Consolidated Vultee) discussed "Flight Testing of Guided Missiles." He outlined the instrumentation for guided missiles which is already available for aircraft and ballistic testing. He stressed the accuracy necessary to obtain satisfactory data and procedures for carrying out the program indicated. Flight testing of missiles can be stated to require great care in instrumentation and experimentation. Also, to obtain full value from the high cost of a guided-missile flight, a thorough analysis must be made.

Buckling Instability and Sandwich Panels

The Structures papers at the Institute always indicate clearly what is agitating structural analysts and designers. Two theoretical papers showed that the problem of buckling is much to the fore, another that structural engineers are intensely interested in sandwich materials.

Bruno A. Boley (Polytechnic Institute of Brooklyn) presented three "Numerical Methods for the Calculation of Elastic Instability." Professor N. J. Hoff of that Institute has managed to inspire a group of excellent workers in advanced structural analysis. Dr. Boley has carried out comparative calculations of reinforced panels in buckling by three methods: (1) the Determinant Method, (2) the Convergence Method, and (3) the Energy Method, making use of an operations method similar to that of Southwell's relaxation procedure. Experiments on sheet and stringer combinations gave results in good agreement with those obtained from each of the three methods of calculation. The investigation will be all the more valuable as a reference for analysts because it discusses the theoretical background of all three methods and illustrates them with numerical examples.

F. R. Shanley (Lockheed) has long given the theory of columns close attention. In his "Inelastic Column Theory" he discusses an idea that was first suggested by Engesser in 1869 and developed by Shanley, but still new to most American engineers. "The reduced-modulus (or double-modulus) theory is not correct for predicting the maximum load up to which a perfect column will remain straight. This is because it is possible for the column to bend simultaneously with increasing axial load. Under such conditions it is possible to have bending without introducing any strain reversal, upon which the reduced-modulus theory depends. The column will begin to bend as soon as the axial load exceeds the value predicted by the tangent-modulus (Engesser) theory. It appeared likely that the Engesser load could be exceeded but that the reduced-modulus load could not be reached. In this paper it will be shown that for an idealized simplified column, this is actually true."

Mr. Shanley's fine introduction is followed by discussion of all three theories and by a close mathematical analysis and careful experimentation. Certain of his conclusions are particularly valuable.

(1) The tangent-modulus (Engesser) formula gives the maximum load at which an initially straight, centrally loaded column will remain straight.

(2) The column load may exceed the tangent-modulus load, but cannot be greater than the reduced-modulus load.

(3) Loading beyond the tangent-modulus load will cause bowing, which will produce permanent bending deformation.

(4) There will be some portion of the column cross section for which the stress will never exceed the tangent-modulus stress.

(5) After the tangent-modulus load is exceeded, the compressive strain over a portion of the cross section will increase much more rapidly than the average strain.

(6) For most engineering materials the decrease in tangent modulus with increasing strain will limit the amount by which the column load may exceed the tangent-modulus value.

(7) The idealized simplified column treated in this paper cannot sustain the reduced-modulus load unless the column is laterally supported while the axial load is being applied.

(8) When supported against bowing during axial loading, a column in the inelastic range will sustain a greater axial load (with support removed) than when loaded without such support.

(9) The tangent-modulus (Engesser) equation should be used as a basis for determining the buckling strength of members in the inelastic range.

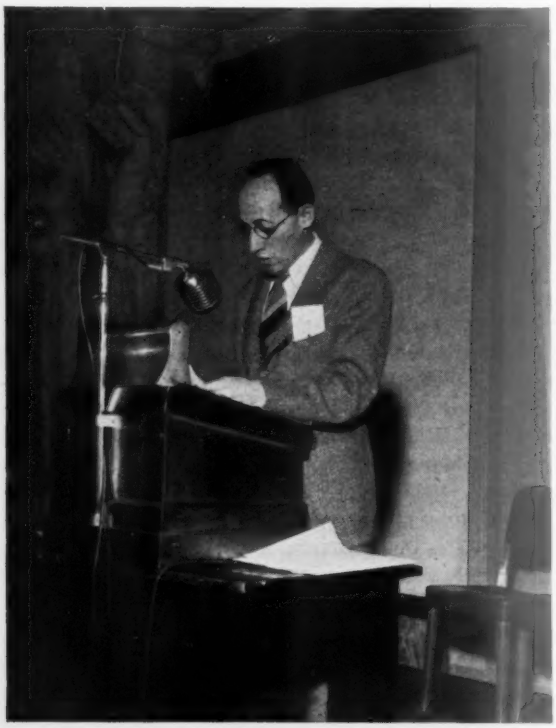
W. W. Troxell and H. C. Engel (The Glenn L. Martin Company) increased our knowledge of the structural properties of sandwich materials in their paper "Column Characteristics of Sandwich Panels Having Honeycomb Cores." The structural characteristics of a sandwich panel are primarily determined by the property of both face and core material and by their relative proportions. Structural requirements indicate the desirability of the light metals as face materials for sandwich constructions. The core must resist crushing and shearing from loads applied perpendicularly to the panel and must be strong enough to prevent premature buckling of the surface sheets. The core need have no ability to resist loads applied in the plane of the panel, for these may be carried by the faces alone. A good core material must have low specific gravity and a high ratio of shearing strength and stiffness to weight.

There is evidence to indicate that a relatively dense material formed into a honeycomb structure possesses advantages as a stabilizing medium. It is only recently that a suitable honeycomb and a satisfactory adhesive for bonding metal faces to the honeycomb have been made available. The paper was restricted to the discussion of a column having aluminum-alloy faces and a single type of honeycomb core. The core was constructed of cotton fabric impregnated with phenolic laminating varnish in regular hexagonal cells with a compressive modulus of elasticity of the order of 23,000 lbs. per sq.in.; a modulus of rigidity in shear of 8,200 lbs. per sq.in.; a shear strength of 110 lbs. per sq.in., and a specific gravity of 0.08.

The tests and considerations cover column strength, wrinkling failure, local buckling, and optimum thickness of surface sheets.

The part of the paper that will be of most interest to structural design engineers is the comparison with all-metal construction. The authors compared the efficiency of 24S-T bare faces on honeycomb with test results of 24S-T zee-stringer panels with flat skins. It was shown that the best zee panels were somewhat more efficient than the sandwich panels over the range of loading parameters covered by the tests, but the relative advantage of the zee panels becomes smaller as the loading parameter decreases. This, however, is only a rough indication of the relative efficiency of the two types of construction, because only a complete comparison including weight of transverse supporting members, connections, and other details would serve to determine the lightest construction. Comparing panels supported only at the ends ignores the advantage possessed by the sandwich construction by reason of its transverse stiffness. This transverse stiffness makes the sandwich type particularly suited to panels of nearly square dimensions or panels that are relatively long parallel to direction of loading and narrow transversely. Weight-saving due to elimination of supporting ribs or transverse formers is a large factor in favor of the sandwich construction.

Another advantage of the sandwich is the smooth surface it presents, while the sheet-stringer combination may show a buckled surface at relatively low load. This is important for the exterior surface of high-speed aircraft.



Nicholas J. Hoff, Chairman, Structures Session.

Almost an International Incident

Little military secrecy is now possible when it comes to "Shooting Stars" and jet-propelled aircraft. Our own descriptions and the generous disclosures of the British have left the subject pretty well wide open. It is unfortunate, therefore, that the session on Aircraft Design was suddenly restricted to United States citizens. Nothing particularly astounding was shown and anybody could come in by merely writing on a card that he was a United States citizen. However, we will restrict ourselves accordingly and write only that which the press considered disclosable. Here is what *The New York Times* reported:

"Describing the development of the Lockheed P-80, the jet plane now standard with the Air Forces, C. L. Johnson, Chief Research Engineer at Lockheed, de-

Paul S. Baker (*right*), Chairman, Aircraft Design Session, discusses paper of C. L. Johnson, with the author (*left*) and Major Gen. L. C. Craigie.

clared the principal need was for improved accuracy in navigation and low-visibility landing techniques made necessary by the plane's speeds in the 600-mile-an-hour range.

"He said the plane had been maneuvered to dive into the compressibility zone associated with the speed of sound at about 750 miles an hour at sea level, and slower at greater altitudes. He reported that he had seen shock waves develop on the P-80's wing tips in such tests.

"Details of the XS-1, the tiny Bell craft that is dropped from a B-29 were described by Walter C. Williams and Robert W. Byrne of the Langley Field laboratories of the National Advisory Committee for Aeronautics, and by R. J. Sandstrom and Robert M. Stanley of the Bell Aircraft Corporation.

"The little plane weighs 13,000 pounds at take-off and only 4,900 pounds at landing because it consumes fuel at the rate of 190 pounds a second while on full power. Yet, climbing with full power from 15,000 feet it has reached almost 80 per cent of the speed of sound. It climbs at the astonishing rate of 120,000 feet, or almost 23 miles a minute."

The Helicopter

One of the curious phenomena of wartime technical aeronautics was the growth of a number of small, highly specialized societies—American Helicopter Society, Aircraft Weight Engineers, Aircraft Industrial Engineers, American Rocket Society. Indicative of the cooperation possible was the Rotating Aircraft Session, which was held under the joint auspices of the Institute and the American Helicopter Society.

Igor I. Sikorsky gave an encouraging and comprehensive view of the whole rotating wing situation in his "Notes on Helicopter Development." Ralph Lightfoot (Sikorsky) discussed "C.A.A. Testing of Helicopters."

There is no further excuse for cloaking helicopter performance in mystery. It is now possible to determine performance just as accurately as for the airplane. It was also encouraging to learn that the extremely complex methods of calculating performance by the use of force component methods is not necessary. Energy methods with appropriate correction factors will serve adequately. Mr. Lightfoot has used simple energy methods with success and satisfaction.

Stalling of the retreating blade is still the worst obstacle to overcome if good high speed is to be obtained. "If a stalled condition is encountered on the retreating blade, more pitch and control will be required to attain a given speed. The stalled condition may cause undesirable vibration before maximum control or power is attained. The situation may be relieved by increased rotor speed or a decrease of forward speed, gross weight or altitude."

It is now possible to correlate all elements of performance by methods of flight testing similar to those of the airplane. There are, of course, special difficulties, such as in finding the helicopter vertical climb. There may be difficulty in maintaining zero air speed, and a slight amount of air speed makes an astounding difference to the apparent vertical climb.

The author made some remarks of particular interest and considerable novelty. "It is also necessary to study partial power descent to determine the region of roughness which lies between the helicopter and autogiro state so that it might be avoided in normal operation. The descent region, varying from approximately 500 to 700 ft. per min. at zero speed to level flight at 60 m.p.h. usually exhibits roughness and partial loss of control especially as vertical descent is approached.

"The optimum pitch or rotor r.p.m. should be determined to insure minimum rate of descent and to establish a safe margin below the stall of the blades. Changes in Delta-3 or Alpha-1 hinge effects will have considerable bearing on the control characteristics in autorotation.

"Critical cooling usually occurs at zero air speed and maximum power. This test may be conducted at hovering ceiling, but the same result may be obtained more easily by overloading the aircraft to lower the hovering ceiling into the ground effect."

The airplane torquemeters seemed to be a means devised for determining power delivered by the engine and that absorbed by the main rotor, auxiliary rotor, transmission, and cooling fan.

In estimating transmission efficiency, Mr. Lightfoot recommends a conservative value of 80 per cent.

The phenomenon of ground resonance has been understood for some time. A helicopter may experience violent vibrations while on the ground with the rotor turning. These vibrations can be explained without considering aerodynamic effects. They involve dynamic coupling between the horizontal hub displacement and the oscillations of the blade in the plane of rotation. A number of papers have already dealt with the problems and engineering recommendations for avoiding dangerous vibrations are available. In "Mechanical Instability of a Two-Blade Helicopter Rotor on Aniso-

tropic Supports," Dr. Robert P. Coleman and A. M. Feingold (N.A.C.A.), extend treatment to a missing case (one or two blades on unequal supports). Skillful use is made of modern methods in solving linear differential equations with periodically varying coefficients.

R. A. Wolf and C. P. Speisz (Bell) took up a more practical problem in "Helicopter Power Plant Installations." The high spots of the paper may be summarized as follows:

(1) The power plant of the helicopter has about the same percentage of the gross weight as a fast single-seater pursuit! And that is why useful and pay load are apt to be disappointing. What is the reason? Excessive power requirements in vertical flight? What can we do about it? Secure from engine builders, engines with characteristics specially suited to the vertical take-off condition.

(2) The helicopter power plant is par excellence a submerged power plant and accessibility is extremely difficult to secure. The designer of a new helicopter had better keep the accessibility of the power plant in mind in the very initial stages of the design!

(3) Ventilating ducts had better be designed with extreme care.

(4) Discharging the exhaust gas into a carefully shaped air ventilating duct may produce a real ejector pump effect, so that ventilating fan losses can be avoided. Since any increase in efficiency reflects itself immediately in the gross weight that the rotor can support, and, hence, in the pay load, the study of ejector cooling systems is a must for the helicopter designer.

Transatlantic Travel

Since the end of the war transatlantic flying has lost many of its friends. Delays at Shannon and in Newfoundland, and waiting-around periods in hotel rooms have disgusted many so much that, having come to the United States by air, they have gone back on the "Queen Elizabeth"—only a day or so slower, but more reliable, and much more fun. The situation is serious. Turbojets and nonstop flight between world capitals at 500 m.p.h. is probably one solution. Is return to the large flying boat another solution? Peter G. Masefield, of the British Ministry of Civil Aviation, argued cogently that it was. The layman always has the feeling that he prefers to travel across the ocean in a flying boat. The runways are infinite in extent, fog at the terminal is less of a hazard and cause for delay than with the landplane. The flying boat is roomier, more comfortable. Forced down at sea it surely will last a few hours more than the landplane. Why did Pan American Airways switch to landplanes? Because of economics and performance.

Mr. Masefield—who is the first man bold enough to quote poetry in a paper before the Institute—cited and vanquished the arguments against the very large boat. To meet the charge that a fleet of motor boats and expensive crews have to support the seaplane, he proposes suitably designed marine terminals and automatic docking. To meet the charge that the landplane is superior aerodynamically, Mr. Masefield made it clear that the aerodynamic difference in a large boat almost vanishes. It is justifiable to quote his well-backed conclusions or summary.

"A design estimate is set out for a 200,000-lb. flying boat and a similar landplane, the boat coming out $2^1/_2$ per cent lighter, the landplane 4 per cent faster, resulting in a small increase of pay load for the boat on a London–New York flight. Comparative costs of a first-class land airport and a similar marine airport are presented, showing a large saving for the flying boat base. . . The conclusions arrived at are that there will be a commercial demand for the large airplane, that in *large* sizes the flying boat has advantages, that the success of the flying boat must depend on the building of specialized marine airports at not more than 20 million dollars each—in short, that the commercial flying boat has a future if the problem is tackled from a long-term point of view."

Turbine Plants for Air Transport?

Mr. Masefield, in his paper on the flying boat, discussed the design of a twin-jet boat of 115,000 lbs. cruising at 445 m.p.h. The British are certainly building jet-powered transports; American Airlines is investigating their use. The question—can turbojets or turboprops be used in transport operation—is timely, and so therefore was the paper by Franklin W. Kolk, of American Airlines, on "Transport Problems with Turbine Power Plants." The advantages as Mr. Kolk sees them are:

(1) The turbo power plant is basically simple and completely isolated in location and function from the rest of the airplane.

(2) Light weight.

(3) Any *cheap*, reasonable fuel can be used.

(4) Increased operating speed in the case of turboprop, and greatly increased speeds with the turbojet.

(5) Absence of vibration and greater comfort.

(6) On the whole, a lesser noise problem.

(7) Greater power plant reliability.

Of course, there are a number of items on the other side. It is only at high speeds and great altitudes that the turbo plants have adequate efficiency. And for high-altitude operation there are many problems to be solved, not the least of which is cabin pressurization. The fuel capacity and reserve required are so enormous that wings no longer provide sufficient volume, fuselage tanks are unsatisfactory, external fuel nacelles at the tips have to be considered. Start-stop distance is critical, ground roll is long (although climb angle is gratifyingly steep). Loss in power due to high ambient temperatures is of greater importance than with reciprocating engines. Approach speeds will be high. As Mr. Kolk says, ". . . and 220 to 230 miles per hour do not seem to be unreasonable figures even with flaps down. Imagine the effects of having a few airplanes holding and approaching at this speed on the standard

instrument approach procedures now in use by all air lines." And further on, "The weakness of the turbine in the low-altitude, low-power regime must be recognized and aggressive steps taken to overcome this defect." Besides intensive redesign of the airplane as a whole, "The big possibility for the improvement of the turbine-powered ship lies with the operators of the airplane. The transport industry must find a way to positively eliminate holding and extensive maneuvering during instrument approaches."

Mr. Kolk does not commit himself, but reading between the lines one imagines that he definitely favors the use of turbo plants for large, fast passenger aircraft. Here is a highly significant paragraph: "If we take an average passenger capacity of 52 and specify ranges up to a transcontinental one-stop operation, we find that such an airplane when powered by four reciprocating engines of about 2,500 hp. for take-off will provide economical transportation at cruising speeds of something in excess of 300 m.p.h. at 20,000 ft. This same airplane might be powered by two turboprops of between 5,000 and 6,000 hp. for take-off and will provide cruising speeds of about 400 m.p.h. at 30,000 ft. A comparable turbojet-powered airplane would be powered by four units of about 5,000 lbs. static thrust for take-off and would provide cruising speeds of between 480 and 500 m.p.h. at 30,000 ft."

What Is the Most Efficient Power Plant?

Mr. Kolk studied the turbo plant purely as an operator, assumed results, and had a pleasant time writing his paper. Joseph H. Keenan and Joseph Kaye (Massachusetts Institute of Technology) really had to work in their "A Survey of the Calculated Performance of Jet Power Plants." Why? First, because the jet power plant has so many more elements than the reciprocating engine—"propeller, diffuser, compressor, combustion chamber, turbine, propulsive nozzle, and reciprocating engine." Second, the computation of efficiency is much more complex than for the reciprocating engine. "The principal reference lines for correlating the efficiencies of moving and stationary power plants are, aside from the axes of coordinates, the line of constant pressure ratio for compression to the temperature at turbine inlet, the line of constant efficiency for Carnot efficiency corresponding to atmospheric and turbine-inlet temperatures, and the curve for the simple gas turbine with reversible compressor and turbine—the latter being also the curve of maximum efficiency for the moving turbopropeller with reversible propeller, diffuser, compressor, turbine, and exhaust nozzle." These two quotations are sufficient evidence of complexity. Therefore, with congratulations to the authors on a fine piece of work, let us summarize and gratefully accept assumptions and results.

Assumptions

(1) The temperature of the air entering the power plant is −48°F. (30,000 ft.)

(2) The air entering a moving power plant is diffused reversibly and adiabatically to zero velocity.

(3) Upon leaving the turbine the air expands *reversibly* and adiabatically, unless otherwise stated, in a nozzle which ejects the stream backwards in the line of motion of the power plant.

(4) No changes in pressure occur between elements of the power plant or in any heater or regenerator.

Definitions

(1) *Regeneration:* Heating the compressed air and cooling the exhaust from the turbine.

(2) *Reheating:* Adding heat at one or more points in the expansion cycle.

(3) *Intercooling:* Between different stages of compression.

Most Significant Results

(1) A stationary gas turbine with regeneration, reheating, and intercooling constitutes an entirely practicable combination for central-station or marine power plants. This combination may attain an efficiency of 44 per cent at a pressure ratio of 8.

(2) The high efficiency, namely 37 per cent, of one compound system (turbojet plus propeller) is not attained by any alternative system except by the ram-jet at speeds in excess of 2,500 m.p.h.

(3) At intermediate speeds the turbojet gives highest efficiency between 700 and 1,800 m.p.h. At about 1,800 m.p.h., turbojet and ram-jet have equal efficiency at a calculated value of 29 per cent.

(4) The order of increasing efficiency for power plants moving at speeds less than 600 m.p.h. is as follows: ram-jet, regenerative ram-jet, turbojet, turbojet with reheat, turbopropeller, regenerative turbopropeller, regenerative turbopropeller with reheat, and, finally, compound engine.

(5) At speeds in excess of the velocity of sound (680 m.p.h.) the turbojet and ram-jet are the power plants of best efficiency among those considered. Of these two the turbojet appears to have the higher efficiency at speeds up to about 1,700 m.p.h. or to a Mach Number of about 2.5.

(6) For a relation between diffuser efficiency and Mach Number that seems to be attainable the calculated efficiency of the ram-jet increases with speed to Mach Numbers greater than 4.5.

The publication of this paper will be awaited with great interest, not only by specialists concerned with the design of power plants, but by men concerned with the selection of power plants for aircraft.

Operational Problems

It is a tribute to the catholic approach of the Institute that the Annual Meeting ranged from high-speed jet aircraft to the helicopter capable of zero speed, from methods of solving differential equations with varying coefficients to the less recondite but equally important question of quick refueling.

Thus Eric Olsen (Wayne Pump) discussed "High-Speed Underwing Fueling," which is important because it is block-to-block speed that interests the transport operator more than cruising speed. Mr. Olsen has made intensive studies of underwing fueling in the last 2 years. Each minute 200 gal. fuel must be made available to each tank in a large aircraft through hose $2^1/_2$ in. in diameter. The flow of fuel into the tank at 200 gal. per min. must be adequately controlled to prevent nozzle pressures, velocities, and impact loads that cause undue stresses in the tank—and this is particularly true of integral tanks. Tests show that when fuel is prop-

erly introduced into the tank at pressures of 5 lbs. per sq.in. or lower, the structure need not be reinforced. There is *less* attendant vapor resulting from 200 gal. per min. of fuel properly introduced underwing, than is now experienced at 50 to 75 gal. per min. overwing. Vent lines must be so designed as to remove all displaced air and vapor as fast as liquid fuel rises in the tank. Bends that build up pressure cannot be tolerated. Safety devices, such as a differential pressure control switch, are all important; float-type shutoffs can operate satisfactorily. Electronic gages where pressure varies capacitance can readily control the pumping equipment. Electronic control equipment is now available which can be operated by one man and gives complete safety.

Mr. Olsen's paper showed that operational problems and safety are almost synonomous terms in aviation, and safety often means fire prevention. Therefore, it is not surprising that there was a Symposium on Aircraft Fire Protection and Prevention. For some obscure reason this session was "restricted." Why? Nobody knows, any more than one knows why the Aircraft Design Session was restricted to citizens of the United States. To use the words "restricted," "confidential," "secret" is a war survival. The practice is useless as a rule but gives a pleasing sense of importance to those responsible for it. Since the paper "Fire Protection Problems of Private Flying" by Jerome Lederer (Aero Insurance Underwriters) was photo-offset and distributed to hundreds of people, there can be no penalty attached to discussing it here! Why are insurance companies so well informed on safety and so zealous in its promotion? Because they pay for losses in case of accidents. But, whatever the motive, the results are good and aviation insurance companies have done more to disseminate knowledge of aviation safety than all other agencies. Mr. Lederer's paper is full of good sense, and is both amusing and fascinating to read. Perhaps you think that you ought to have a fire extinguisher on your plane? A superficial thought. "Aircraft owners forget to keep them filled . . . tie them down . . . found in inaccessible baggage compartments . . . no use for fires that occur ahead of the fire wall . . . the pilot should not use the hand-type fire extinguisher because the important thing for him to do is to land as soon as possible and, anyway, it requires both hands." Mr. Lederer cites some instances of fires in the air (many of which could have been readily avoided) and concludes that the incidence of fire-in-the-air in personal-type aircraft appears to be relatively rare but the consequences are often extremely serious.

More serious than fire in the air are fires following crash. "In 1944 only 10 per cent of the 341 fatal and serious crashes resulted in a fire following crash but these accounted for 30 per cent of the fatalities. . . It is reasonably certain that there would have been more survivors if fire had not occurred following the crashes and this will be more certainly true in the future as the aviation industry adopts the work of deHaven in preventing crash injuries."

Can We Make Weather?

Mark Twain said, "Everyone talks about the weather and no one does anything about it." He might not be able to say that today. The Meteorology Session focused attention on the possibility that a new era may be at hand when we shall make weather to suit ourselves. Experiments in fog dissipation, by dropping electrified sand, by the use of huge oil heaters, have been going on for many years. But these were feeble beginnings. Now signs come from many quarters that a real attack will soon be possible. With what weapons?

First of all, by exploration of the upper air so that our knowledge of the factors involved is greatly extended. Nolan R. Best (Naval Research Laboratory) writing on "Pressure Measurements in the Upper Atmosphere" described how with the help of V-2 rockets fired at White Sands, N.M., direct measurements have been made of pressures in the upper atmosphere. Ambient pressures were measured directly in locations near the tail with tungsten wire Pirani gages. A few days after the Meteorology Session, the N.A.C.A. gave a remarkable interpretation of the V-2 researches. There is a 170°F. hot zone extending from an altitude of about 30 miles to an altitude of more than 40 miles. There is a lower layer where temperature rises because heavy oxygen, O_3 or ozone, acts as a protective screen against ultraviolet rays from the sun. The second rise in temperature occurring at the greater height is due to cosmic dust particles which hold more heat than the atmosphere below, and to ionization or exchange of free electrons in the Kennelly-Heaviside layer. These are breathtaking discoveries.

As Prof. John von Neumann (Princeton University) put it in the summary of his paper on "The Future Role of Rapid Computing in Meteorology": "If full mathematical treatment could be given to the physical data, a considerably more reliable system of forecasting could be achieved. Present methods of analysis of the equations expressing the operation of the natural factors are inadequate. The equations turn out to be partial differential equations (possibly combined with certain integral equations) occurring in several parallel alternating schemes, the alteration being controlled by various inequalities. These equations can be calculated numerically, if it is done about 100,000 times faster than with the present 'manual' methods."

Dr. V. K. Zworykin (Radio Corporation of America) in a "Discussion of the Possibility of Weather Control" said, first of all, that the electronic computing devices (which would be miniature models of all the factors entering into weather) would synthesize all elements and enable rapid and more accurate predictions to be made. Then the wise forecaster could apply energy in small doses strategically, from spreads of blazing oil to heat critical portions of the atmosphere or blacked-over areas to cool them. The meteorologist would recognize the beginnings of a hurricane in the doldrums, near the equator, in time to order oil spread and fired at a critical point where it would break up the

formation. Or he might spread artificial white fog on the ground or at sea to create heat through reflection of the sun's rays. Or he might spread carbon black on either land or sea to absorb the rays and thus cool a critical point in the air mass. Dr. Zworykin said in effect that while the energies involved in storms are enormous, the amount of energy required to "trigger" them off so that they would do no harm might be insignificant!

The final paper of the Thursday morning program was by Dr. Ben G. Holzman, Colonel, A.A.F., Research and Development, Headquarters, Army Air Forces, "A New Operational Basis for Weather Forecasting." He proposed that the forecaster be freed from the time-consuming tasks of preparing weather maps and cross sections, so that he could devote himself to the problems of forecasting to a far greater degree than is now possible. Only by such division of labor did Colonel Holzman see any prospect for full utilization of the great body of surface and upper air data and their treatment by modern techniques, without which we must continue to have forecasts little, if any, better than were made before such an overwhelming mass of data became available. Dr. Landsberg commented on the lack of improvement in forecasting which Colonel Holzman had shown, and mentioned that Köppen, in the 1880's, in Hamburg, had found forecast verifications to average about 75 per cent on a certain scale, which, applied to present-day forecasts by Dr. Landsberg, had yielded about the same result. From this he concluded that, not only had there been no noticeable improvement in general forecasting in the war years, but, indeed, none to speak of over the last 60 years or so. This led Dr. Landsberg to remark that perhaps we should consider seriously Dr. Irving Langmuir's comment at the recent Boston meeting of the Society that perhaps meteorological events constituted a divergent phenomenon and so could not be forecast.

Someone made the complaint that at present the map used by forecasters is already some 10 hours old, and suggested the possibility of automatic instruments continuously reporting and feeding the data into analyzing machines. He mentioned also the need for continuously measuring ceilometers for airports instead of always dealing with an observation at some past time. Dr. Zworykin said that Dr. Holzman's paper substantiated his point of view that the amount of material in meteorology is so great that the use of machines is necessary to handle it.

Another speaker indicated that whether or not students and schools should devote more time to training in forecasting and less to plotting and analysis, as suggested by Dr. Holzman, would depend on whether or not the weather services would be set up for, and demand, this type of meteorologist. Would the weather services install apparatus for the distribution of analyses by facsimile? Dr. Holzman replied that the A.A.F. already had and that he hoped others would follow.

Aircraft Fire Protection and Prevention

A Symposium on "Aircraft Fire Protection and Prevention" was held during the evening session on January 30 under the joint auspices of the Institute and the National Fire Protection Association. Speakers included Harvey L. Hansberry dealing with the subject "Aircraft Design Fire Problems," W. E. Koneczny speaking on the "Fire Protection Problems of Commercial Flying," Jerome Lederer talking on "Fire Protection Problems of Private Flying," Major Allen G. Hart on "The Fire Problem as Viewed by the Army Air Forces," and George H. Tryon on "Some Aspects of Aircraft Fire Fighting."

Colonel Edwin E. Aldrin, who represents the Institute on the N.F.P.A. Committee on Aviation and Airport Fire Protection, was Chairman of the session and in his introduction he emphasized that the meeting was designed to bring to light some of the outstanding fire problems in the design, operation, and maintenance of aircraft through an open exchange of thoughts by all those in attendance.

Mr. Hansberry emphasized the necessity to consider the fire hazards in the design development stage and praised the action of some manufacturers who had appointed fire engineers to check all blueprints for this specific purpose. Mr. Koneczny emphasized the versatility of aircraft fire hazards and pointed out the necessity for greater control over maintenance by the operators with the view of detecting hazards and mechanical difficulties before they become serious or occur under unfavorable circumstances.

Twenty-five specific recommendations for design improvements in personal aircraft were made by Mr. Lederer for the mitigation of the dangers of fire in flight and at time of crash impact. He pointed out that past experience indicated that crash impact fires were of greater frequency than air-borne fires. Major Hart stated that while fire did not appear to the Flying Safety Service to be a predominating cause of accidents, it often occurred as a contributing factor to an unsafe act or an unsafe condition. He cited some statistics on the A.A.F. experience during 1945 and 1946 and emphasized that the results of the A.A.F. accident analysis work would increasingly become available to civilian agencies having a legitimate interest in the subject.

Mr. Tryon, in speaking of the problems connected with aircraft rescue and fire fighting, emphasized the limitations that were imposed upon fire fighters and bluntly told the aeronautical engineers present that they had created the problem that existed in much the same way that the architects who built the Winecoff Hotel were responsible for the tragic loss of life in the recent fire in Atlanta. In his closing remarks he called for nine specific engineering advances that would aid in reducing the fire threat at time of ground impact.

A stimulating discussion period followed the prepared talks during which time Dr. L. G. Lederer, Medical Director of Capital Airlines showed some lantern slides of actual crash fires.

I.A.S. Briefs

Summaries of current papers received for publication or presentation at I. A. S. meetings

This Section, started in the January, 1947, issue of the REVIEW, *has been established to give advance and current information on papers presented to the Institute for publication or for presentation at meetings. Summaries of all pertinent papers, including those given at Section and Student Branch meetings, will be published each month in these columns as rapidly as they are received from authors.*

Many of these papers, after being processed by the Editorial Committee in the usual manner, will appear in full in later issues of the JOURNAL *or* REVIEW. *Preprints of some papers are immediately available, or will become available at an early date, at a price of 25 cents each (to cover handling costs) to I.A.S. members, and 75 cents each to nonmembers. Requests for preprints should be addressed to Editorial Department, Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.*

Aerodynamics

Oscillating Air Forces and Flutter at Supersonic Speeds (Two-Dimensional Case)

By

I. E. Garrick

National Advisory Committee for Aeronautics

An account is given of the determination of the air forces on an oscillating airfoil moving forward at supersonic speed, with particular reference to the method of Possio. Application is made to the study of wing flutter in the degrees of freedom, bending, and torsion. The results indicate that flutter may occur at supersonic speeds, but for more restricted ranges of the parameters than for subsonic speeds. High torsional stiffness and forward locations of the center of gravity are the most important technical safeguards. Some curves of flutter speed against Mach Number are shown, including extrapolations with subsonic values. Brief mention is made of wing divergence, aileron reversal, and of a one-degree-of-freedom oscillatory instability in torsion. The paper is essentially based on material of *N.A.C.A. Technical Note 1158* by S. I. Rubinow and the author.

Aerodynamic Performance of Delta Wings

By

H. J. Stewart and A. E. Puckett

California Institute of Technology

In recently published papers, the authors have discussed the problem of drag of delta wings with straight trailing edges (A. E. Puckett, JOURNAL OF THE AERONAUTICAL SCIENCES, September, 1946) and also the lift of this type of wing (H. J. Stewart, *Quarterly Applied Mathematics*, October, 1946). The present paper consists of an extension of these results to delta wings with swept-back or swept-forward trailing edges. Drag at zero lift for two slope surfaces and lift is computed for these airfoils, and a discussion is given of the drag due to lift. Centers of pressure are also computed. In addition, some results for drag of wings with three slope surfaces are given. Discussion is made of optimum design from the standpoint of leading and trailing edge angles, and location of maximum thickness. It is shown that considerable improvements over two-dimensional airfoil performance can be obtained. Results are presented in the form of conventional engineering coefficients.

Aircraft Design

Development of the Lockheed P-80A Jet Fighter Airplane

By

C. L. Johnson

Lockheed Aircraft Corporation

This paper presents the results of research and development on the P-80 Jet Fighter, covering such factors as the effect of aerodynamic smoothness, power-plant installation problems with particular reference to water injection for thrust increase, and the problems encountered with flutter and vibration. The development of wing-tip fuel tanks, and various intake duct and tail-pipe modifications are also covered. Reference

is made to some of the outstanding service problems and their possible solutions. The author's recommendations for further developments applying to jet aircraft as a type are included.

Aircraft Propulsion

Performance Charts for the Turbojet Engine

By
Benjamin Pinkel and Irving M. Karp
National Advisory Committee for Aeronautics

Convenient charts are presented for computing the thrust, fuel consumption, and other performance values of a turbojet engine for any given set of operating conditions and component efficiencies. The effects of the pressure losses in the inlet duct and combustion chamber, the variation in the physical properties of the gas as it passes through the cycle, and the change in mass flow by the addition of fuel are included. The principal performance charts show the effects of the primary variables and correction charts provide the effects of the secondary variables.

Some of the performance and operational characteristics of the turbojet engine are illustrated by a discussion of several typical cases. It is shown, for example, that although thrust per unit mass rate of airflow increases with increased combustor discharge temperature, for minimum specific fuel consumption, however, an optimum combustor outlet temperature exists which in some cases may be less than the limiting temperature imposed by strength-temperature characteristics of present materials.

Selection and Design of Rocket Power Plants

By
W. C. Roberts
Bell Aircraft Corporation

(1) *Propellant Selection.*—The selection of a propellant for a particular use will be partially determined by its availability and its cost. For several generally available propellants a comparison may be made from a cost standpoint. Performance or potentialities of performance will also affect the choice of a propellant, as will the special problems relating to its storage, handling, or utilization. It is not intended that this discussion will result in any definite selection, but factors pertinent to such a selection will be introduced and discussed.

(2) *Fuel System Selection and Design.*—System types such as pumped systems, pressurized systems, etc., will be briefly discussed, and optimum design pressures will be evaluated and related to net specific impulse as a criterion in design. The effect of proposed usage upon piping, tanking, special devices, etc., will be noted. It is hoped that sufficient data will become available to permit quantitative comparisons of several systems.

(3) *Rocket Motor Design.*—The calculation of nozzle shape and size based on general rocket parameters will be developed. Chamber shape and size will also be discussed. Cooling considerations, covered in detail by Mr. Reinhardt, will be reviewed and application to design will be made. Materials and such fabrication techniques as may be made public will be described. Other details of the rocket motor and interrelated parts, such as injectors and igniters, will be discussed.

This column will normally contain summaries of papers received from all sources. Because of space limitations and the number to be covered, this issue is devoted exclusively to papers presented at the Fifteenth Annual Meeting of the Institute in New York, January 28, 29, and 30, 1947.

Summaries of the addresses given by the Hon. W. Averell Harriman at the Honors Night Dinner, by Major Gen. L. C. Craigie at the Army Day Luncheon, and by the Hon. William A. M. Burden at the C.A.A. Day luncheon, will be found elsewhere in this issue.

Air Transport

Effect of High-Speed Fueling on Aircraft Design

By
Eric Olsen
The Wayne Pump Company

An attempt is made herein to (1) establish requirements for the rapid refueling of aircraft insofar as they affect airplane design; (2) evaluate the magnitude of design problems presented by these requirements; (3) offer data pertinent to the practical and economical solution of these problems; and (4) present certain conclusions and recommendations.

It is concluded that necessary modification of existing aircraft or new design does not present a formidable handicap to the designer; the so-called system for return of vapor and/or solid fuel to the supply from vents is not a safety requirement and presents design problems and weight penalties in excess of its value; simple, reliable safety measures for the protection of the aircraft can and must be provided.

Certain suggestions and recommendations are made based upon the results of laboratory tests and field experience which, it is hoped, will circumvent the customary tedious process of investigation.

The Flying Boat and Its Commercial Future

By
Peter G. Masefield
Ministry of Civil Aviation, Great Britain

The possibilities of the flying boat for commercial air transport are examined from two main points of view—technical and operational. The questions are posed: Is the large airplane required for air-line services and can specialized marine airports be provided economically? After analysis, the answer to each of these questions is found to be in the affirmative. The nine main criticisms against the commercial flying boat are set down and discussed, and the conclusion is reached that these basic objections can be overcome economically if the boat is of adequate size and if adequate marine

bases with automatic docking apparatus are provided. This automatic docking apparatus is described, and requirements for a marine base are given.

A design estimate is included for a 200,000-lb. flying boat and a similar landplane, the boat coming out $2^1/_2$ per cent lighter, the landplane 4 per cent faster, resulting in a small increase of pay load for the boat on a London–New York flight. Comparative costs of a first-class land airport and a similar marine airport are presented, showing a large saving for the flying-boat base. Possible flying-boat routes are analyzed in relation to the Saunders Roe SR-45 boats of 300,000 lbs. each now under construction for B.O.A.C. The design of a 115,000-lb. twin jet boat, cruising at 445 m.p.h., is detailed.

The conclusions arrived at are that there will be a commercial demand for the large airplane, that in large sizes the flying boat has advantages, that the success of the flying boat must depend on the building of specialized marine airports at not more than 20 million dollars each—in short, that the commercial flying boat has a future if the problem is tackled from a long-term point of view.

Flight Test

Raydist—A Precision Radio Navigation and Tracking System

By
Charles E. Hastings
Hastings Instrument Company

RAYDIST is a highly accurate and sensitive electronic distance-measuring system which is applicable to many aeronautical problems where precise determination of position is required. The system allows relatively short distances to be measured accurately and is capable of detecting a 1-in. movement of a small transmitter. RAYDIST is also capable of measuring the longer distances and is not limited to line-of-sight measurements. Radar-type instruments have been used to make accurate measurements over long distances but previous methods have had minimum measurement limitations many times larger than that of the RAYDIST system.

Error in the RAYDIST system results only from variations in the frequency of a single transmitter and from radio propagation phenomena. By the use of a high-quality crystal-controlled transmitter, the accuracy of RAYDIST is limited only by the consistency of radio propagation phenomena.

Meteorology

A New Operational Basis for Weather Forecasting

By
B. G. Holzman
Army Air Forces

Numerous wartime meteorological researches have contributed greatly to our understanding of the mechanism of atmospheric processes but any resultant improvement in weather forecast accuracy to date has been highly questionable. Wartime experiences have emphasized that the usual complement of personnel in a weather station is wholly inadequate and incapable of analyzing and digesting the abundant data in the form of surface observations, rasonde-rawin soundings, pilot reports, and weather reconnaissance reports now available to the meteorologists. Although meteorologists are not agreed as to its operational feasibility, the concept of divorcing analysis from forecasting was demonstrated to be, in all major operational efforts during the war, the only practicable solution to the problem of making maximum use of available data. The establishment of key analysis centers manned by expert analysts who devote their entire energies to the analysis of weather data in chart form which are transmitted by facsimile to the field forecaster has proved to be the best and only method for handling the wealth of available weather information and has resulted in maximum efficiency in the preparation of forecasts. A principle was established that forecasting responsibility must be decentralized and given to those meteorologists immediately associated with the particular forecasting problem. The recognition and application of the principle of separation of analysis from forecasting will result in an immediate increase in forecast efficiency and accuracy and will create the only firm basis upon which private meteorology can be established.

Rotating Wing Aircraft

C.A.A. Testing of Helicopters

By
Ralph B. Lightfoot
United Aircraft Corporation

The performance of a helicopter may be determined by methods similar to those used on conventional aircraft. Particular difference exists in evaluating vertical climb performance and establishing values of profile and parasite drag. Methods have been established to correlate power, gross weight, rotor speed, forward speed, altitude, and temperature by accounting for transmission efficiency, changes in profile drag with mean lift, and parasite drag with speed. The resultant agreement with the original aerodynamic analysis falls within the accuracy of flight-test measurement. Absolute values of efficiency parasite and profile drags must be determined with torquemeters and full-scale wind-tunnel tests. Otherwise, relative values may be assigned each parameter to render satisfactory performance analysis.

Helicopter Power-Plant Installations

By
Robert A. Wolf and Carl P. Spiesz
Bell Aircraft Corporation

This is an informal discussion with illustrations on the overall problems of power-plant installation and design as applied to present-day helicopters. There are some comparisons with more familiar fixed wing installations but the greater part of the paper is confined to those problems generic to the helicopter. Based primarily on Bell Aircraft Corporation's experiences, this paper reviews some of the problems encountered during the past few years and some of the solutions. It also discloses many of the controversial decisions that have to be made in the practical design of helicopters. Part of the paper is general and deals with the basic performance of power plants, including rotor drives, transmissions, and supercharger. The other part of the paper deals with the more

specific problems of submerged engine installations, cooling and induction systems, and engine suspension systems, and includes a brief discussion of fuel and oil systems and engine accessories.

Structures

The Dynamics of a Swept Wing

By
Herbert R. Lawrence, Adam T. Zahorski, and William E. Cox
Northrop Aircraft, Inc.

It is assumed that a swept wing may be represented dynamically by a plane curved rod of variable section with finite stiffness in torsion and in bending normal to its plane. The equations of motion for this configuration are exhibited with the restriction that the curvature of the elastic axis be finite. By allowing the curvature to become infinite at a point, certain auxiliary conditions are obtained at the bend. The engineering application of this theory is presented and subdivided into three parts: (1) determination of free modes of vibration coupled in bending and torsion for a uniform swept-back beam; (2) determination of modes for a nonuniform beam; and (3) determination of the dynamic load due to the impact of landing. A simple harmonic motion of a wing at the incipiency of flutter is assumed to be representable as a linear combination of a finite number of the natural coupled bending and twisting modes of the wing.

Computation of Influence Coefficients for Aircraft Structures with Discontinuities and Sweepback

By
Samuel Levy
National Bureau of Standards

A general method for computing influence coefficients is outlined which used Castigliano's theorem together with a stress analysis of the airplane structure based primarily on equilibrium conditions. It is shown by means of examples that this method is particularly suited to wings having discontinuities, cutouts, and sweepback. It is also particularly suited to taking account of end fixity at the wing root.

A method is also presented for use of the influence coefficients in computing, by iteration, the normal modes of vibration of an airplane as a free body in either symmetric or antisymmetric motion. This method avoids the necessity for knowing the location of the elastic axis and gives directly the coupled torsion and bending modes.

Inelastic Column Theory

By
F. R. Shanley
Lockheed Aircraft Corporation

The action of a column in the plastic range is analyzed on the basis that bending may proceed simultaneously with increasing axial load. This leads to a new column formula that includes both the tangent-modulus (Engesser) and the reduced-modulus (von Kármán) formulas. It is shown that bending begins at the tangent-modulus load and that the column load increases with increasing lateral deflection, approaching the reduced-modulus load as a limit if the tangent modulus is assumed to remain constant.

Numerical Methods for the Calculation of Elastic Instability

By
Bruno A. Boley
Polytechnic Institute of Brooklyn

Three numerical methods for the evaluation of buckling loads requiring an operations table similar to that used in Southwell's relaxation procedure are developed and described—the Determinant Method, the Convergence Method, and the Energy Method. The Determinant Method makes use of the fact that the determinant made up by the elements of the operations table vanishes at buckling. The convergence criterion is that a systematic relaxation process based on the operations table is convergent only if the structure is stable. The principle that the second variation of the total potential is zero during buckling forms the basis of the energy method.

The theoretic background of the three methods is discussed after a review of the setting up of operations tables and of Southwell's method in general. The procedure to be followed in each method is given and illustrated in numerical examples. Experiments on sheet and stringer combinations carried out at the Polytechnic Institute of Brooklyn Aeronautical Laboratories (PIBAL) are described, the results of which are in good agreement with each of the three methods of calculation.

Column Characteristics of Sandwich Panels Having Honeycomb Cores

By
W. W. Troxell and H. C. Engel
The Glenn L. Martin Company

The column characteristics of panels having metal faces and honeycomb cores are reviewed. Compressive behavior is shown to be determined by the elastic properties of the face metal and by the shear rigidity of the stabilizing medium. A theory of column behavior, which considers the shear rigidity of the core and the reduced elastic properties of the face material at stresses above its elastic limit, is developed and shown to be in accord with experimental data. Optimum panel construction, i.e., the ratio of face thickness to total thickness which yields the maximum strength-weight ratio is discussed and related to a loading parameter that measures the intensity of loading on the structure. Comparison of the structural efficiency of honeycomb panels with all-metal construction shows the sandwich to be the less efficient simple column. It is pointed out, however, that this comparison ignores the advantage of the transverse stiffness of the sandwich which comes into play in square panels or in those which are relatively long parallel to the direction of loading and narrow transversely.

New B. F. Goodrich assembly gives maintenance men a break

THE Braniff International Airways mechanic shown in the picture is completing one of the easiest of his maintenance duties. He's just overhauled a B. F. Goodrich Expander Tube brake. The mechanic likes the brake because he doesn't have to tear the whole thing down to replace the brake lining, and he doesn't need a lot of special tools to do the work.

The engineers at Braniff like the extremely low maintenance cost. There are two reasons why that cost figure is so low. The brake needs *less* maintenance when it is in the shop, and it is in the shop less often than other type brakes. One reason for this is that a hydraulically operated tube forces brake blocks against the brake drum *evenly* all the way around. This results in powerful action with minimum pressure and minimum wear.

The designer likes the simplicity of design for another reason. The B. F. Goodrich Expander Tube brake can be made lighter for a given amount of kinetic energy than any other type brake. From the Lockheed Constitution to the Piper Cub, this advantage has proved itself on every type of modern aircraft.

B. F. Goodrich Silvertown tires, wheels and brakes are now sold as a complete assembly—an important new service to airlines and to manufacturers. *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

B.F.Goodrich

FIRST IN RUBBER

Aeronautical Reviews

Aerodynamics

Oscillating Air Forces and Flutter at Supersonic Speeds (Two-Dimensional Case). I. E. Garrick. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 36 of this issue, March, 1947.)

Aerodynamic Performance of Delta Wings. H. J. Stewart and A. E. Puckett. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 36 of this issue, March, 1947.)

Aerodynamic Characteristics of Rectangular Wings at Supersonic Speeds. E. Arthur Bonney. *Journal of the Aeronautical Sciences*, Vol. 14, No. 2, February, 1947, pp. 110–116, figs. 7 references.

By the combined use of the "Busemann second order approximation" theory for the pressure distribution over a two-dimensional airfoil with a straight leading edge (normal to the flow) and the theory for the loss in lift at the tips of a rectangular airfoil in supersonic flow, expressions for lift, drag, and moment coefficients and center of pressure are derived for the rectangular type of wing. It is shown that, contrary to subsonic theory, the drag due to lift of a rectangular airfoil will decrease with decreasing aspect ratio; the lift and moment coefficients will also decrease, and the center of pressure will move forward. Increased thickness ratio will cause the center of pressure to move forward markedly for airfoils of finite and infinite aspect ratio. Wave form drag will vary as the square of the thickness ratio, and airfoils of symmetrical cross section with maximum thickness at the mid-chord point will have the least wave-form drag for a given thickness ratio. The analysis is limited to angles of attack below which the shock wave detaches from the leading edge of the wing.

Laminar Boundary-Layer Oscillations and Stability of Laminar Flow. G. B. Schubauer and H. K. Skramstad. *Journal of the Aeronautical Sciences*, Vol. 14, No. 2, February, 1947, pp. 69–78, figs. 8 references.

An account is given of an experimental investigation in which sinusoidal velocity fluctuations were discovered in the laminar boundary layer of a flat plate and in which the characteristics of these fluctuations were studied in detail and found to agree with the characteristics predicted earlier by the Tollmien-Schlichting stability theory. This work confirmed the theory, settling a controversy of many years and throwing new light on the causes of transition from laminar to turbulent flow. The fluctuations are termed "laminar boundary-layer oscillations" to distinguish them from the irregular velocity fluctuations previously observed by other investigators. In earlier investigations these oscillations were not found, probably because of the high turbulence in the wind tunnels in which investigations were conducted. The present investigation was conducted in a wind tunnel of turbulence much less than 0.1 per cent. The oscillations were readily detected and studied by means of the hot-wire anemometer. A description is given of the methods used to produce and study boundary-layer oscillations. By these methods the oscillations are found to consist of a wave motion in the boundary layer. Amplified, damped, and neutral waves are found, and these characteristics, together with wave velocities and type of wave motion, are in accord with theory. Attention is called to the subsequent theoretical work of C. C. Lin, and some of Lin's results are given.

Theoretical Lift and Drag of Thin Triangular Wings at Supersonic Speeds. Clinton E. Brown. *U.S., N.A.C.A., Technical Note No. 1183*, December, 1946. 25 pp., figs. 7 references.

A method is derived for calculating the lift and the drag due to lift of point-forward triangular wings and a restricted series of swept-back wings at supersonic speeds. The elementary or "supersonic source" solution of the linearized equation of motion is used to find the potential function of a line of doublets. The flow about the triangular flat plate is then obtained by a surface distribution of these doublet lines. The lift-curve slope of triangular wings is found to be a function of the ratio of the tangent of the apex angle to the tangent of the Mach angle. As the apex angle approaches and becomes greater than the Mach angle, the lift coefficient of the triangular wing becomes equal to that of a two-dimensional supersonic airfoil at the same Mach Number. The drag coefficient due to lift of triangular wings with leading edges behind the Mach cone is shown to be close to that of elliptically loaded wings of the same aspect ratio in subsonic flight. The resultant force on wings with leading edges outside the Mach cone, however, is shown to act normal to the surface and thus

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an induced drag equal to the lift times the angle of attack is obtained.

Flight Investigation of the Effect of a Local Change in Wing Contour on Chordwise Pressure Distribution at High Speeds. Richard E. Adams and Norman S. Silsby. *U.S., N.A.C.A., Technical Note No. 1152*, September, 1946. 11 pp., figs. 2 references.

Tests were made in high-speed flight with a fighter airplane to determine the effect on the chordwise pressure distribution resulting from a minor modification in the contour of the wing upper surface. The contour modification consisted of the addition of a faired bulge with a maximum depth of 0.13 per cent chord, extending approximately from 35 to 55 per cent chord. Chordwise pressure distributions were obtained on the original and modified contours over a range of flight Mach Numbers from 0.55 to 0.75. The tests showed that the change in wing contour had a large effect on the pressure distribution when the critical Mach Number was exceeded. The critical Mach Number of the modified contour was about 0.01 lower than that of the original contour.

Investigation of Turbulent Mixing Processes. K. Viktorin. (*Forschung auf dem Gebiete des Ingenieurwesens*, Vol. 12, No. 1, January-February, 1941.) *U.S., N.A.C.A., Technical Memorandum No. 1096*, October, 1946. 32 pp., figs. 6 references.

Using water as the driving and delivered medium in a device similar to a simple jet apparatus, the pressure and velocity fields of the mixing zone were explored with a pitot bar. A mathematical analysis of the mixing flow by integration of the equation of motion, with the aid of conventional formulas for the turbulent shearing stress, succeeded only approximately for an extremely simplified case in which a driving jet is introduced in an unlimited parallel flow, while the pressure over the whole mixing field is assumed to be constant. However, the form of the measured and computed velocity profiles indicated a high degree of agreement. Success in the prediction of such mixing fields on the basis of Prandtl's formula for turbulent shearing stress was limited because of mathematical difficulties.

Determination of l_p by Free Rolling. J. M. Evans and P. T. Fink. *Australia, Council for Scientific and Industrial Research, Division of Aeronautics, Report No. A.43*, August, 1946. 58 pp., illus. 17 references.

A free rolling method for determining the rolling derivative due to rate of roll was investigated, and proved rapid and accurate in use despite irregularities in the rolling speed of the tunnel stream. The theory given to take account of such irregularities led to a simple experimental technique. Some experiments dealing with the stream variations are described in an appendix. Results are given of tests on the same model of a Boomerang fighter in two wind tunnels. The effects of rate of roll, aileron deflection, and Reynolds Number were determined. Tests with the wing alone were made to find the effect of lift coefficient, fuselage and tail group, and Reynolds Number on rolling derivative due to rate of roll. The results are compared with lifting line theory.

Transition Indication in the National Physical Laboratory 20 in. × 8 in. High-Speed Tunnel. D. W. Holder. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2079*, July 27, 1945. 13 pp., illus. 8 references. British Information Services, New York. $0.90.

A description is given of the development of two methods of indicating the position from laminar to turbulent flow in the boundary layer of an airfoil model. The more successful method is an adaptation of the "china clay" technique of Richards and Burstall. Experiments made on a two-dimensional model of EC 1250 section indicate that above the critical Mach Number the transition point positions on the airfoil surfaces coincide with the positions of the shock waves, moving aft with increase of Mach Number. Below the critical Mach Number, measurements of profile drag, when there is no separation, are in fair agreement with an extrapolation of the theoretic values calculated by Winterbottom and Squire for the mean of observed transition positions and the Reynolds Number of the experiment. The presence of the tunnel walls, and any leaks that may occur there in practice, do not appear to influence the transition position over the middle half of the span on which pressure plotting and wake-traverse measurements are normally made.

Determination of Profile Drag at High Speeds by a Pitot Traverse Method. C. N. H. Lock, W. F. Hilton, and S. Goldstein. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 1971*, September 19, 1940. 39 pp., figs. 12 references. British Information Services, New York. $2.00.

Measurements of the stagnation temperature in the wake behind an airfoil, together with theoretic arguments, suggest that it is sufficiently accurate to calculate the profile drag of an airfoil from the results of wake measurements of total head and static pressure on the assumption that the total energy is constant. It is further assumed that for the purposes of calculation, mean streamlines may be drawn in the wake along each of which the total head (or the entropy) is constant. Formulas are developed for deducing the profile drag coefficient from total-head and static-pressure traverses. Traverses at 0.85 chord and 0.20 chord behind the trailing edge of an airfoil produced results in fairly satisfactory agreement. Discrepancies between values of the drag deduced from wake explorations and measured on a balance are satisfactorily accounted for by end effects on the portions of the airfoil in the tunnel boundary layer.

The Influence of Remote and Flexible Mass-Balance Arms on Elevator Flutter. I—Elevator Mass-Balance in Relation to Flexibility of the Arm and Position of Fuselage Nodal Point. D. Williams. **II—Experiments on the Influence on Symmetrical Elevator Flutter of Remote Mass-Balance Arm Systems with Various Flexibilities and Gear Ratios.** C. Scruton and W. G. Raymer. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2062*, June, 1944. 21 pp., figs. 2 references. British Information Services, New York. $1.20.

I. Flexibility of the arms is shown to be a factor of considerable importance, in reducing below its nominal value the mass required for mass balance, especially when that property is accentuated by the interposition of a system of linkage between the control surface and its mass balance. **II.** A comparison was made between the minimum mass required in the elevator nose to eliminate flutter and the minimum masses for remote arms of angular gear ratios 1 and 2. Tests were made also on the effect of balance-arm flexibility. The results confirm that (1) the advantages due to gearing-up the motion of the balance mass by the use of a remote balance system may be offset to a large extent by the forward position of the balance-arm hinge; and (2) a given mass added to a flexible arm is equivalent to a stipulated mass added to a rigid arm, where two of the factors of the latter expression are, respectively, the natural frequency of the mass on its arm and the flutter frequency. Thus, increase of balance-arm flexibility decreases the balance.

The Influence of Aspect Ratio and Taper on the Fundamental Damping Derivative Coefficient for Flexural Motion. J. B. Bratt and C. J. Davis. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2032*, February 14, 1945. 20 pp., figs. 4 references. British Information Services, New York. $1.20.

By means of relatively simple apparatus employing the method of free decaying oscillations, measurements were made for a set of five rigid airfoils. The effect of the frequency parameter for a given Reynolds Number was investigated by variation of the natural frequency of the system. Systematic tests also were carried out to determine the influence of the rate of decay of the oscillations. The paper includes a description of the apparatus and an account of the experimental technique. Experimental results are tabulated and also presented in the form of curves. A comparison is made with available theoretic results.

Aeroelastic Problems at High Speed. A. R. Collar. *The Royal Aeronautical Society, Journal*, Vol. 51, No. 433, January, 1947, pp. 1–22, Discussion, pp. 23–34, figs. 30 references.

The methods used and the results obtained so far in analytic attacks on these problems are outlined. The problems discussed include the effect of wing twisting on aileron control; the effects of distortion of the fuselage and tail unit of a conventional aircraft on longitudinal control and stability; flutter effects; and aeroelastic problems of sweepback. Speculations on the broad implications of the problems from the design point of view are included.

Low Drag Aerofoils. L. G. Whitehead. *The Royal Aeronautical Society, Journal*, Vol. 51, No. 433, January, 1947, pp. 54–64, figs.

During the past few years a new series of low-drag airfoils has been developed which represents a radical departure from earlier practice. The changes envisaged are much greater than those which accompanied the general change-over from the biplane to the monoplane and give rise to many problems whose solution requires considerable theoretic and experimental work. The theoretic basis of the design and application of the modified profiles as aircraft wing sections is discussed with particular reference

to the design of airfoils for flight at speeds below the critical Mach Number at which shock waves are first formed. Consideration is given to the nature of wing drag, the influence of transition on the drag coefficient, the application of new sections, boundary-layer flow, conditions favorable to delayed transition, theoretic methods of design, symmetric profiles, and compressibility limitations.

Investigations of Compression Shocks and Boundary Layers in Gases Moving at High Speed. J. Ackeret, F. Feldmann, and N. Rott. (*Zürich, Eidgenössische Technische Hochschule, Institut für Aerodynamik, Mitteilung Nr. 10,* 1946. 57 pp., illus.) *U.S., N.A.C.A., Technical Memorandum No. 1113,* January, 1947. 72 pp., illus.

The mutual influences of the compression shocks and the friction boundary layers were examined experimentally. A comparison of measurements taken in various high-speed wind tunnels has shown that the same shock picture does not always appear. Friction effects were considered to be of importance and the experimental results showed that the shock picture is different for a laminar than for a turbulent boundary layer. For the laminar case the shock pattern is much more complicated. The tests were made in the high-speed wind tunnel of the Institute for Aerodynamics at the Federal Academy for Technology, which has the advantage of permitting the determination of the Mach Number and the Reynolds Number effects separately, through provision for varying the density of the gas at constant velocity.

Untersuchungen an Verdichtungsstössen und Grenzschichten in Schnell Bewegten Gasen. J. Ackeret, F. Feldmann, and N. Rott. *Zürich, Eidgenössische Technische Hochschule, Institut für Aerodynamik, Mitteilung Nr. 10,* 1946. 57 pp., illus. Verlag AG. Gebr. Leemann & Co., Zürich. 8 Sw. fr. (See preceding abstract.)

A Study of Compression Shocks with Boundary-Layer Separation. Eggink. (*Aachen, Technische Hochschule, ZWB/FB/1850,* August, 1943.) *U.S., Army Air Forces, Translation No. F-TS-1026-RE,* December, 1946. 18 pp., figs.

It is known that compression shocks produce a transition from supersonic to subsonic flow, and cause separation of the flow on an airfoil section. The forms of these shocks are investigated on bodies of revolution, wing sections, and in Laval nozzles with high back pressure.

Influence of an Electric Field on the Air Flow Around a Body. O. Ruchti. (*ZWB/UM/Re/3533,* August, 1944). *U.S., Army Air Forces, Translation No. F-TS-1056-RE,* December, 1946. 13 pp., illus.

The results of pressure-distribution measurements obtained on two cylinders and one symmetric profile exposed to an electric field in the test chamber of a smoke tunnel. They proved a strong influence on the air stream surrounding a body by a field of sufficient intensity. The observability of these effects, however, with test equipment used is confined to low air speeds.

High Speed Flight. T. R. F. Nonweiler. *British Interplanetary Society, Journal,* Vol. 6, No. 3, December, 1946, pp. 90–98, figs. (Extended abstract of a paper.)

Consideration is given to the pattern of the airflow past wings and bodies when the speed is low and the air behaves as an incompressible fluid; when it is subsonic but sufficiently large to bring about local changes in the density of the air; and at supersonic speeds. The aerodynamic forces on the wings, control problems of high-speed subsonic flight, aerodynamic skin heating, and other factors are discussed.

Mach-Reynolds Relation Probed. John R. Spreiter and Paul J. Steffen. *SAE Journal,* Vol. 55, No. 1, January, 1947, pp. 33–39, figs. (Extended abstract of a paper: "An NACA Flight and Wind-Tunnel Investigation of Maximum Lift as Affected by Variations of Mach and Reynolds Numbers.")

Early tests, conducted either at full-scale Reynolds Numbers and low Mach Numbers or at small Reynolds Numbers and high Mach Numbers, demonstrated the need for data on the combination of full-scale Reynolds and high Mach Numbers. Particulars are given about the flight tests carried out to obtain this information, which covered the ranges of Mach Numbers from 0.15 to 0.72 and of Reynolds Numbers from 4,400,000 to 19,500,000. Conclusions reached from an analysis of the test results are presented.

Birds Can Fly. J. Laurence Pritchard. *Flight,* Vol. 50, No. 1983, December 26, 1946, pp. 700a–700d, illus.

Low-Speed Aerodynamic Research. *Aircraft Engineering,* Vol. 18, No. 214, December, 1946, p. 412.

Modern Gas Dynamics. B. V. Korvin-Kroukovsky. *The Engineers' Digest,* Vol. 3, No. 12, December, 1946, p. 587, illus. A general statement of the principles of reaction propulsion and the problems of high-velocity airflow.

Air Transport—General

Arctic Air Transport. Trevor Lloyd. *Air Affairs,* Vol. 1, No. 2, December, 1946, pp. 218–232.

Early long-distance polar flights and exploration trips by Americans and others are recounted in a review of the progress of aviation in the northern latitudes. An outline of air-transport operations in the Arctic during the war tells of the completeness of the equipment and the efficiency with which these bases were managed. Details are given about the routes flown, the importance of northern air operations, and the commercial uses that can be made of the facilities and experience gained.

Engine Research and Civil Aviation. E. L. Bass. *Aircraft* (Melbourne), Vol. 25, No. 3, December, 1946, pp. 16–19, 40, 42, figs.

The practical relation to civil aviation of some research problems is discussed with particular reference to air-line economies. The conflicting requirements for civil aviation are defined and discussed in the order of priority under the headings of safety, reliability and frequency of service, speed, low cost, and comfort.

New Frontiers. L. Welch Pogue. *Air Affairs,* Vol. 1, No. 2, December, 1946, pp. 165–177.

New forms of transportation have opened new sources of demand and have developed a far larger volume of new business than they have diverted from older methods. Records of railroad passenger and freight movement, water travel, postal receipts, and other statistics demonstrate that broadening facilities always generate increased utilization. Aviation has enabled business to expand greatly the radius of its operations, developing new markets that had been beyond its reach in earlier times. Political frontiers have also expanded, making it necessary to alter methods of international travel and trade. Better understanding of the peoples of the world will result from the opportunities for closer relationships with other people offered by air transportation, thereby lessening the likelihood of war.

Recent Developments in United States International Air Transport Policy. Oswald Ryan. *Air Affairs,* Vol. 1, No. 1, September, 1946, pp. 45–66.

The history of international civil aviation is reviewed briefly, with an outline of the political and nationalistic considerations that limited general agreement on terms governing international air transportation before and during the recent war. At the

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

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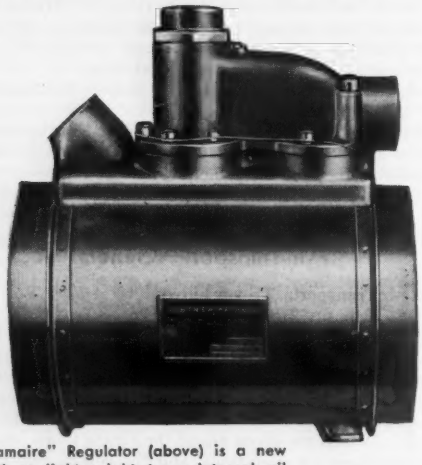

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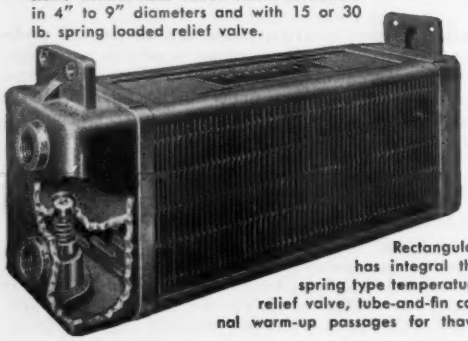

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International Civil Aviation Conference at Chicago in 1944, matters of intergovernmental control encountered divergent views and led to the establishment of the Provisional International Civil Aviation Organization. At the Bermuda Conference and other meetings, agreements were reached regarding rate-making procedures and schedules. The principle of regulation by national aeronautical authorities in consultation has received the widest acceptance. More extensive experience in international aviation is needed for the evaluation of current proposals for economic control formulas and for the establishment of a definite policy. The effective development of a vast potential market will require constant technological and commercial improvement, which can best be achieved by economic competition.

EATS Is an Excellent Operation. Brooks Parker. *U.S. Air Services*, Vol. 31, No. 12, December, 1946, pp. 11, 30, illus.

Thorough inspection of maintenance stations and trips over the routes flown within the continent of Europe by the European Air Transport Service of the A.A.F. reveal that the flight operations and the maintenance work are of a high order of efficiency and compare favorably with any other domestic or foreign air-transport service.

New CAA Rules Foster Greater Flying Safety. R. W. Ayer and F. F. Fennema. *SAE Journal*, Vol. 55, No. 1, January, 1947, pp. 47–50, figs. (Extended abstract of a paper "The Effect of the New Civil Air Regulations on Scheduled Air Transportation.") Discussion of the rules on air-transport operation and design.

Notes from PICAO Experience. Edward Warner. *Air Affairs*, Vol. 1, No. 1, September, 1946, pp. 30–44.

The accomplishments of the Provisional International Civil Aviation Organization in its first year are reviewed by the President of its Interim Council. Comments are made about the powers, functions, and responsibilities of the organization.

Civil Aviation in India. *The Air-Log*, Vol. 8, No. 9, November, 1946, pp. 24, 26. A description of India's civil aviation activities, with a reference map showing operating and proposed air services in that country.

Air Transport, Cargo

Air Freight and Government Regulation. H. Struve Hensel. *Air Transportation*, Vol. 9, No. 6, December, 1946, pp. 17, 18, 20, 22, 26, illus.

New Government air cargo regulations should be permitted to develop with the industry and its requirements, and should not be fixed by planning at a time when the exact future of the industry is unknown.

What Air Freight Carriers Can Expect from New York's Glamor Industry. I. L. H. Brittin, Bertram Ault, and Roger Mayhill. *Air Transportation*, Vol. 9, No. 6, December, 1946, pp. 28–33, illus.

A report on a study of the air-cargo potentials in the New York women's apparel industry. The study was undertaken as a part of the New York Metropolitan Shippers Air Freight Survey to provide the air-cargo operator hauling perishables in the Greater New York area with a basis on which to plan for and develop return loads, as well as to explore the ways in which industry can benefit from the development of air transport.

One Year of Air Freight. Daniel H. Ecker. *Air Transportation*, Vol. 9, No. 6, December, 1946, pp. 36–38, illus. Observations on the development of nonscheduled air-freight operations during the year 1946. The activities of the leading companies and the prospects for future operations are surveyed.

A World at the Shipper's Fingertips. Irving B. Babcock. *Air Transportation*, Vol. 9, No. 6, December, 1946, pp. 10–12, 14, illus.

How air transport has solved transportation problems in South America. Air traffic between the United States and Russia also is discussed, and examples are given of the economies that can be realized through air transport.

Airfreight—Via American. F. D. Miller. *Airports*, Vol. 10, No. 6, December, 1946, pp. 24, 25, illus. A short outline of American Airlines' freight-handling system.

Contract Carrier Builds Cargo Business with Service. Scholer Bangs. *Air Transport*, Vol. 5, No. 1, January, 1947, pp. 37–41, illus. The story of how California Eastern Airways, organized in San Francisco in 1945 by six wartime pilots, is building up cargo business through efficient service.

Trends in Air Cargo. John H. Frederick. *Distribution Age*,

Vol. 46, No. 1, January, 1947, pp. 38, 40, 55, illus. A survey reveals that the scheduled air lines are actively seeking more cargo business and are realistically facing the problems of pickup and delivery.

Economics. Not Glamor. J. Prescott Blount. *Air Transportation*, Vol. 9, No. 6, December, 1946, pp. 7, 8, 40, illus. The advantages to the shipper of transporting perishables by air freight.

Air Transport, Scheduled

Airlines' Year-End Review. *Air Transport Assn. of America, Release*, December 26, 1946. 4 pp.

Report on air-transport activities in 1946 gives statistics on passenger-miles, express and freight shipments, route mileage, air mail, load factors, equipment in use, and other items, for domestic and international operations.

Lists of Holders of Certificates of Public Convenience and Necessity, Foreign Air Carrier Permits, Certificates of Public Convenience and Necessity Involving Service Wholly Within Alaska, and Applicants. *U.S., Civil Aeronautics Board*, January 1, 1947. 22 pp. Names and addresses of 69 holders of certificates or permits, and 438 applicants.

Air Transport in 1946: Records of Some Typical Airlines: Notable Traffic Figures Reported. *Modern Transport*, Vol. 51, No. 1453, January 18, 1947, p. 7.

History of the U.K.-India-Australia Air Route. *Indian Aviation*, Vol. 30, No. 10, October, 1946, pp. 228, 230.

The Airlines . . . And the Public. II. George P. Saunders. *Air Transport*, Vol. 5, No. 1, January, 1947, pp. 42–45, diagr.

The development of an effective airline public relations program to meet postwar problems is discussed. A flow diagram of such a program is presented.

Airline Reservations. *Western Flying*, Vol. 27, No. 1, January, 1947, pp. 24, 25, illus. New reservation systems developed by Western Air Lines, Inc., and United Air Lines, Inc., are described.

Airplane Descriptions

Development of the Lockheed P-80—A Jet Fighter Airplane. C. L. Johnson. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 36 of this issue, March, 1947.)

The Skystreak. Edward H. Heinemann. *Douglas Aircraft Co., Inc., Release*, February 5, 1947. 16 pp., illus.

The Douglas XD-558 Skystreak was designed with the cooperation of the Navy Bureau of Aeronautics and the N.A.C.A. as a high-speed transonic-type test airplane for research purposes. It has a gross weight of 9,750 lbs. with full internal fuel load and a wing area of 150 sq.ft. This results in a wing loading of 65 lbs. per sq.ft. for take-off and 56 lbs. per sq.ft. for landing. To safeguard against unexpected air loads that may be encountered near sonic speeds, sufficient strength has been provided to stand stresses at the speed of sound at sea level, and an ultimate or breaking load factor of 18*g* with an applied (safe working) load of 12*g*. The General Electric axial-flow turbojet TG-180 power plant is located in the fuselage over the wing and occupies the major portion of the space within the fuselage. Details are given of the structure, the jettisonable cockpit, and the flight-test instruments.

Newest Experimental Patrol Plane Combines Two Jet Units with Two of Largest Conventional Type Engines. *U.S., Navy Dept., Release*, February 10, 1947. 1 p.

The Martin XP4M-1 Navy Patrol airplane has a maximum speed of well over 350 m.p.h. and a maximum range of over 3,000 miles. Normal cruising speed exceeds 200 m.p.h. Power for cruising and normal operation is provided by two Pratt & Whitney R-4360-4 engines of 3,000 hp. each. Mounted behind the two reciprocating engines, in the same nacelles, are two Allison J33-4 turbojet engines, each developing 4,000 lbs. thrust, which provide additional power. Landing gear is of tricycle design, with the main wheels folding outward into wells in the wings. Designed by The Glenn L. Martin Company, the plane has a gross take-off weight of more than 78,000 lbs., wing span of 114 ft., length of 82½ ft., and normally carries a crew of eight. The plane is equipped with the latest in search radar.

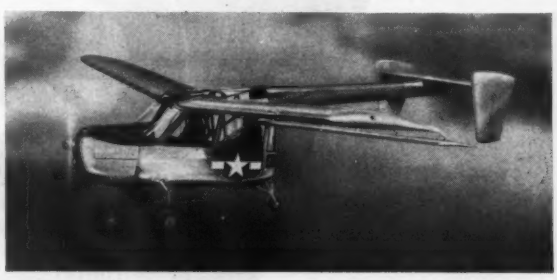
Ryan Develops the XF2R-1. *Ryan Aeronautical Co., Release*, January 20, 1947. 3 pp., illus.

Like the basic FR-1 Fireball Navy fighter, the new Ryan XF2R-1 uses a two-engine power-plant combination, with the front engine turning a propeller. Power for the propeller is supplied by a General Electric TG-100 gas-turbine propjet engine. The XF2R-1 has a General Electric I-16 thermal jet engine installed in the aft fuselage section to supplement the power of the propeller for bursts of speed and faster climb. An extended forward fuselage section to house the gas-turbine engine has increased the plane's overall length to 36 ft. To take care of the increased torque, from both the propeller and the turbine wheel, a larger dorsal-fin section has been added to the standard FR-1 fuselage-tail structure. Total power of the two engines of the XF2R-1 is considerably in excess of that of the reciprocating and jet-engine combination of the FR-1.

The First Twin-Jet Tailless Aircraft. I, II. *The Aeroplane*, Vol. 71, Nos. 1856, 1857, December 20, 27, 1946; pp. 748–753; pp. 773–777; illus.

An extensive article on the Armstrong Whitworth A.W.52 describes the type of control employed, general production methods, details of the construction and design of the wing and control surfaces, the pressurized fuselage, undercarriage, power unit installation, and fuel system. The A.W.52 is a tailless aircraft powered by two Rolls-Royce Nene jet units and has a pressure cabin for a crew of two. The flying controls are similar to those of the Armstrong Whitworth all-wing research glider. A retractable nose-wheel type Dowty landing gear with a steerable nose wheel provides control on the ground. Extreme care was taken to preserve a smooth surface, the laminar-flow wing and the heavy-gage Alclad skin being specially protected during manufacture.

Twin-Jet A.W.52. *Flight*, Vol. 50, No. 1982, December 19, 1946, pp. 674a–679, illus. (Cf. preceding abstract.)



The Boeing L-15A liaison plane is adaptable for observation, communication, and photographic work. The wings, boom, and tail section can be turned inward for stowage or quickly disassembled. (See "L-15A for Army Ground Forces Liaison Work has 'Pod' Fuselage and 'Upside Down' Tail Surfaces.")

L-15A for Army Ground Forces Liaison Work has "Pod" Fuselage and "Upside Down" Tail Surfaces. *Boeing Aircraft Co., Release*, January 19, 1947. 2 pp., illus.

Primary mission of the L-15A is that of an aerial observation craft, particularly for spotting and directing artillery fire. The airplane is equipped with full-span, fully extended, nonretractable flaps of the external, airfoil type. These may be adjusted from the normal zero setting to 10° up or 40° down, and act differentially in conjunction with spoiler-type ailerons. The gondola enclosure hangs below the level of all flight surfaces, affording full vision in all directions. With its 125-hp. Lycoming engine the craft will climb to 628 ft. in 1 min. It has a service ceiling of 16,400 ft. and can fly at speeds ranging from less than 50 m.p.h. for observation work to a maximum of 112 m.p.h. Cruising speed is 101 m.p.h. Length of the L-15A is 26 ft. 1.2 in.; wing span, 40 ft.; height, 8 ft. 8½ in.; normal gross weight, 2,050 lbs.; and useful load, 541 lbs.

The Goodyear GA-2. *Goodyear Aircraft Corp., Release*, December 28, 1946. 2 pp.

The GA-2 three-place experimental amphibian, informally called the "Duck," is not scheduled for current production but was designed to test Goodyear aviation equipment. Powered by a 145-hp. Franklin horizontally opposed air-cooled engine, the airplane has a constant-speed Koppers Aeromatic pusher-type propeller with cooling spinner. The boat hull of the aircraft is of stressed-skin construction employing 24-ST Alclad covering. The wings are of all-metal structure, fabric covered, with wing-tip slots and laminated plastic wing floats having no external bracing. The electrically operated, fully retractable landing

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gear, including tail wheel, can be manually operated in case of electrical failure. The wing span is 36 ft.; overall length, 26 ft.; cruising speed, 110 m.p.h.; and maximum speed, 125 m.p.h.

Prototype of Volmer VJ-21 Tested. *Volmer Aircraft Co., Release*, Reed. December 30, 1946. 2 pp., illus.

The Volmer VJ-21, formerly the Jarvis VJ-21, is an all-metal, three-place pusher. Basic performance data, following flight tests, show a cruising speed of 110 m.p.h. with a Continental C-75 engine; a top speed of 120 m.p.h.; climb (first minute), 750 ft.; and take-off run, 400 ft. The cruising range of the production model will be 500 miles. Other specifications are: wing span, 38 ft.; length, 23 ft.; wing area, 150 sq.ft.; weight empty, 850 lbs.

The Amazing Airphibian. C. B. Colby. *Skyways*, Vol. 6, No. 2, February, 1947, pp. 31, 76, illus.

Particulars are given about a combination automobile and airplane designed by Robert E. Fulton, Jr. The machine is constructed in two sections that can be quickly joined together to form an aircraft. The front section is a convertible coupe; the rear section comprises the rear half of the fuselage and tail unit, and the wings and cabin top, all in one unit.

Aero Digest's 1947 Chart of U.S. Warplanes. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 98–103, illus. Tabulated specifications and illustrations of 95 aircraft in current use by the Army and Navy.

1947 Annual Directory of Transport Aircraft. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 36, 40, 42, 44, 46, 48, 50, 52, illus. Specifications of over 25 aircraft.

1947 Annual Directory of Personal Aircraft. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 56 ff. (11 pp.), illus. Specifications of over 50 aircraft.

Two New All-Jet Fighters Join Navy's Air Arm (North American XFJ-1 and Vought XFGU-1). *Aviation*, Vol. 46, No. 1, January, 1947, p. 65, illus. (Cf. AER 1/47:38.)

TCA Story of the North Star Growth from Idea to Airliner. J. T. Dyment. *Canadian Aviation*, Vol. 20, No. 1, January, 1947, pp. 43–45, 54, illus. Details are given about the design features and modifications made to meet the requirements of the air line for the services to be rendered.

Canadair Converts Specification into Merlin-Powered Douglas. P. W. Gooch. *Canadian Aviation*, Vol. 20, No. 1, January, 1947, pp. 46–48, 54, diagr.

The final DC-4M differs considerably from the aircraft originally planned and actually has features of the basic C-54, the DC-4, and the DC-6, as well as incorporating Merlin engines. An exploded view of the aircraft shows the main components. Information is given about the electric system, installation of the power plant, hydraulic system, air-conditioning system, furnishings, and other features.

Convair Producing All-Metal L-13 Liaison. *Aviation*, Vol. 46, No. 1, January, 1947, p. 66, illus. (Cf. AER 1/47:39.)

News from Russia. *The Aeroplane Spotter*, Vol. 7, No. 178, December 26, 1946, p. 306, illus. Brief descriptions of the PO-2 ambulance biplane, the Omega helicopter, and the LI-2 (Russian DC-3) two-engined transport, with illustrations of the latter two aircraft.

Rebirth of French Wings. Henri A. de Villermont. *American Helicopter*, Vol. 5, No. 11, January, 1947, pp. 26, 27, 31, illus. Consists chiefly of descriptions of recent French aircraft.

French Plane Industry Accents Variety. Michael Marsh. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 74, 75, 78, illus.

The Paris Aero Show. *Aeronautics*, Vol. 15, No. 6, January, 1947, pp. 26–35, illus. (Cf. AER 2/47:35.) Includes tabulated specifications of 31 French light planes.

The Paris Aero Show—1946. *The Aeroplane Spotter*, Vol. 7, No. 177, December 14, 1946, pp. 291–301, illus. (Cf. AER 2/47:35.) Specifications, photographs, and three-view diagrams of 53 aircraft exhibited.

The Curtiss Racers (1922–25). Roger Huntington. *Air Trails*, Vol. 27, No. 5, February, 1947, pp. 40, 41, 114–116, illus.

German Jet Projects. *The Aeroplane*, Vol. 72, No. 1860, January 17, 1947, p. 70, illus. Brief specifications of the Focke-Wulf II and Me P.1110 fighters.

The S.I.A.I. Marchetti S.95. *The Aeroplane*, Vol. 72, No. 1861, January 24, 1947, p. 116, illus.

Airplane Design

The Jet Airplane Utilizing Boundary Layer Air for Propulsion. A. M. O. Smith and Howard E. Roberts. *Journal of the Aeronautical Sciences*, Vol. 14, No. 2, February, 1947, pp. 97–109 ,128, figs. 14 references.

Recent theory has indicated the important fact that, whereas a natural laminar boundary layer is definitely limited in extent, this limit can be removed by use of continuous boundary-layer removal. Possibilities of large drag reductions are pointed out and a discussion of several of the aerodynamic problems of removing the boundary layer is presented. A specific study is included comparing a large conventional airplane with the boundary-layer control jet type, and pointing out the salient features. The boundary-layer control jet airplane considered is found to excel the conventional in its pay-load carrying ability up to about 2,020 miles, whereas a jet airplane with ramming intake can excel it up to only 1,310 miles. These ranges are cruised at 430 m.p.h., 400 m.p.h., and 200 m.p.h., respectively, for the boundary layer intake jet, ramming intake jet, and conventional airplane. The drag reductions due to the removal of the boundary layer are based upon existing test data.

Design and Development of the Douglas XB-42. Carlos Wood. *Aeronautical Engineering Review*, Vol. 6, No. 1, January, 1947, pp. 22–29, figs.

The initial design problem of the Douglas XB-42 was to improve on conventional arrangement and eliminate the usual disadvantages such as nacelle profile drag, instability due to forward propeller location, and control troubles when one engine is inoperative. The desired configuration included a clean wing enclosing the cooling system, fuel, and possible armament; a fuselage enclosing the engines, equipment, crew, and bombs; and remotely driven propellers providing "centerline" thrust behind the tail surfaces. In addition to problems of general arrangement including the proper position of the landing gear, the aerodynamic problems involved power-on stability, control in yaw, nose-wheel lift-off, and propeller vibration. Larger elevators and rudders contributed to the control solutions, and vibrations were minimized by using slotted flaps and snap-action bomb doors. Control-surface balancing and ducting solved other aerodynamic problems.

Tailoring the Cockpit to Fit the Pilot. Albert J. Zack. *The Pegasus*, Vol. 9, No. 2, February, 1947, pp. 1–4, 16, illus.

Design principles applied in the layout of the cockpits of recent training and operational airplanes are intended to facilitate the use of the controls with the least possible confusion and fatigue to the pilot. The following principles in cockpit design were formulated: (1) Each control should look like the part of the airplane it actuates, e.g., in the Fairchild XNQ and the Douglas AD-1, the landing-gear lever actually is shaped like a wheel and strut. (2) The control should be placed in the cockpit in a position corresponding as closely as possible to the position of the plane part it controls. (3) The control should move in the same direction and through the same arc as the part to be operated. (4) To turn controls on or to increase them, they should be pushed up or forward. Switches should be turned clockwise for on, counterclockwise for off. (5) The pilot should not be required to actuate controls more than once to accomplish the desired work. Space measurements, shoulder harness, color, and lighting were also considered.

In "Operation Turtle" Design Turned the Trick. Thomas D. Davies and Hugh L. Hanson. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 70, 71, illus.

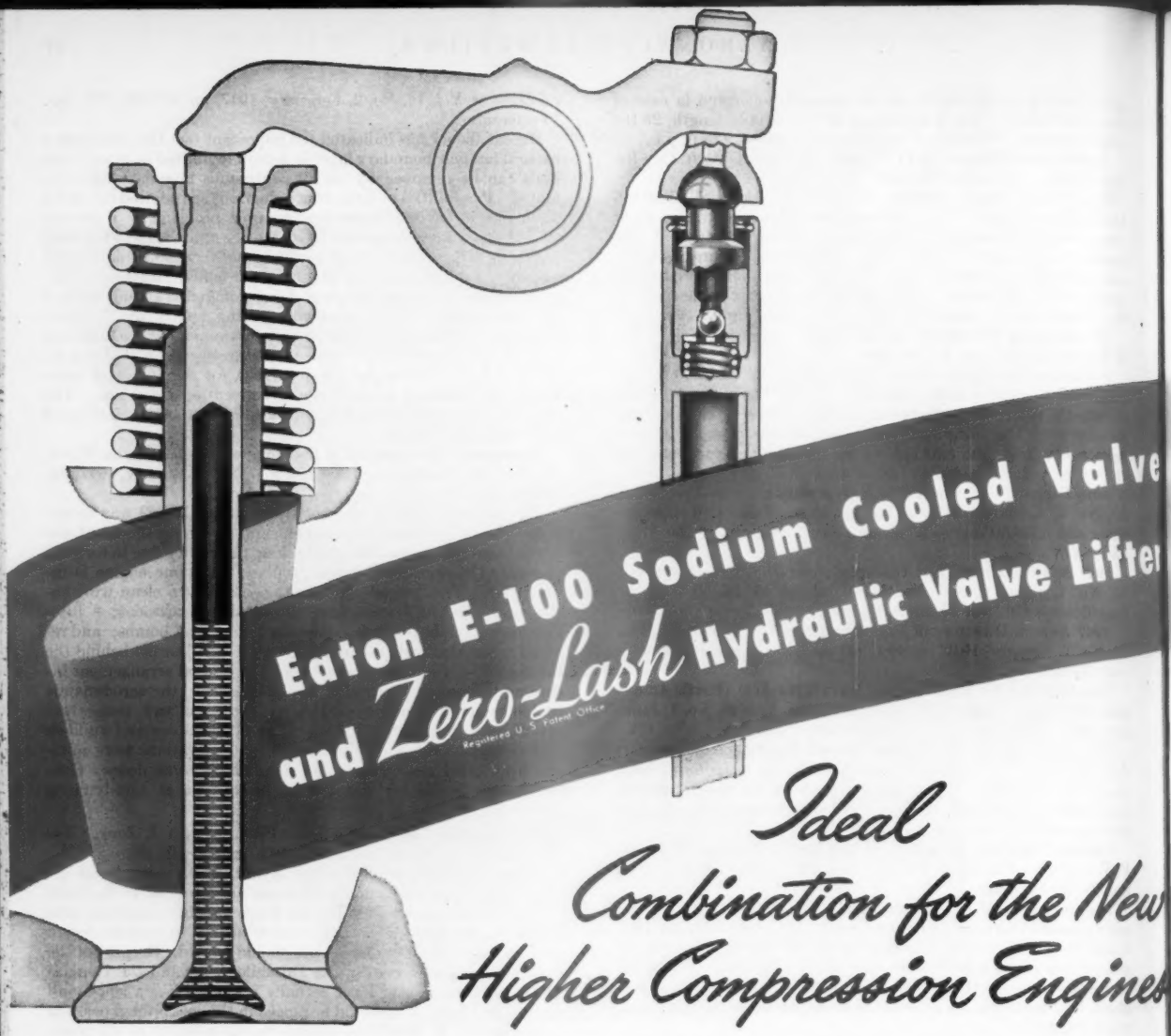
The design features that enabled the Lockheed P2V "Truculent Turtle" patrol airplane to make a nonstop flight from Perth, Australia, to Columbus, Ohio, are reviewed, including aerodynamic considerations and fuel tank capacity. The preparations made for the record flight and the navigation methods used during the trip are outlined. Data on the flight are presented in a table.

Improved Mail-Express Pick-Up for D-18-C's. *Aviation Maintenance & Operations*, Vol. 7, No. 2, January, 1947, pp. 33, 80–83, illus.

The new combination air pick-up passenger aircraft operated by All American Aviation, Inc., are equipped to pick up mail and express at normal cruising speeds. The modifications and apparatus required to accomplish this are described.

Transports —Today and Beyond. Glenn L. Martin. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 35, 208, illus.

The President of The Glenn L. Martin Company forecasts for the near future airplanes not radically different in outward configuration, but affording a gain of 50 per cent in speed, greater comfort and dependability, increased efficiency, and much greater economy of operation.



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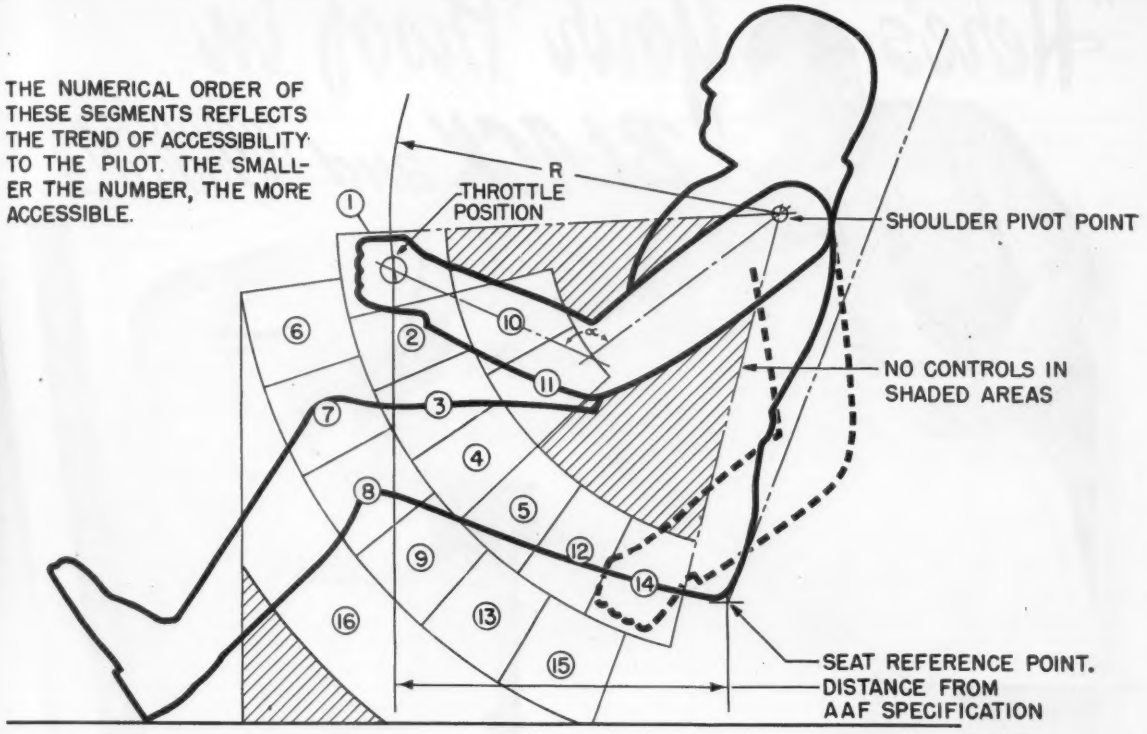
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DISTANCE FROM AAF SPECIFICATION

Zones of accessibility of a typical fighter airplane, developed by Northrop Aircraft, Inc., in determining best locations for controls and other cockpit equipment. (See "Toward Better Cockpits; An Engineering Approach.")

Toward Better Cockpits; an Engineering Approach. Stanley A. Hall. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 47–51, illus.

Ten of the more important but almost universally neglected elements that affect cockpit design are listed. A formula developed by Northrop Aircraft, Inc., provides a means to evaluate which controls are most used and what locations are most accessible.

Problems in the Selection of Aircraft Accessory Equipment. E. W. Anger, Jr. *Automotive and Aviation Industries*, Vol. 96, No. 2, January 15, 1947, pp. 39, 86, 88.

Difficulties encountered by the aircraft engineer in the selection of appropriate accessory equipment and alternate equipment are described. The technical information that should be readily available in a manufacturer's catalog for review by the aircraft engineer in the selection of aircraft equipment is briefly outlined.

Lightplanes—Today and Beyond. William T. Piper. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 55, 211, illus.

The President of Piper Aircraft Corporation reviews the progress of the personal-airplane industry and analyzes the market for private airplanes.

Per Viam ad Astra. Philip D. Banbury. *Aeronautics*, Vol. 15, No. 6, January, 1947, pp. 46, 47, figs.

Viewpoints on the design of a combined airplane and motor car, with drawings of various hypothetic designs, include what the writer considers the final answer to the problem. This is a "tailless" pusher with backswept folding wings. Some estimates of the performance of such a road-air car are included.

Aeronautics in 1946. I—III. *The Engineer*, Vol. 183, Nos. 4747, 4748, 4749, January 3, 10, 17, 1947; pp. 9–12; pp. 42–44; pp. 67, 68; illus. **I.** Civil, military, and naval aircraft design. **II.** Developments in the design of rotating wing aircraft and gas turbines. **III.** Some details of projected and experimental aircraft.

1946 Was Year of Development for AAF. *U.S., War Dept., Public Relations Div., Release*, January 2, 1947. 6 pp.

Navy Planes—Today and Beyond. A. W. Radford. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 96, 205, illus. Current types of naval aircraft are described.

Naval Aircraft. A. N. Clifton. *Flight*, Vol. 51, No. 1984, January 2, 1947, pp. 8–10, illus. (Extended abstract of a paper.) The development of naval aircraft is outlined and some of the design requirements for modern craft of this type are stated.

Aircraft for "Flat Tops." II—Two Engines or One? *Air Affairs* (London), No. 17, December, 1946, p. 3, illus. (Cf. AER 2/47:37.)

"In My Opinion"; Reginald G. Standerwick and Geoffrey Smith Compare Notes on Future Aircraft Design and Propulsion. *Flight*, Vol. 50, No. 1981, December 12, 1946, pp. 646, 647.

Design Details of the Martin 202. Irving Stone. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 38–43, illus. (Cf. AER 10/46: 43.) A study of the numerous engineering refinements incorporated in this twin-engined transport airplane, including the elaborate provisions for low-cost maintenance.

Trace B-29 Potency to Tailored Design. E. C. Wells. *SAE Journal*, Vol. 55, No. 1, January, 1947, pp. 40–42, 55, illus. (Extended abstract of a paper: "The History and Development of the B-29.")

The integration of operating procedures with weight and drag effects are asserted to be vital to the success of any long-range aircraft. The progressive performance improvements of the B-29 are largely attributed to developing these procedures to match the airplane and the conditions under which it must operate. Several cases are cited where weight and drag troubles were experienced because operating conditions were neglected. Realization of this relationship led to changes that raised the bomb load of the B-29 from 5,000 to 20,000 lbs. and at the same time increased the range of the aircraft.

North Star Leads Trend to Automatic Flight. James T. Bain. *Canadian Aviation*, Vol. 20, No. 1, January, 1947, pp. 40, 41, illus.

Modifications made to fit the conditions encountered in the service of Trans-Canada Air Lines were simplification of the pilots' instruments, use of automatic control equipment, and improvements in maintenance procedures.

Grumman's New Mallard Has Novel Refinements. I. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 82, 83, illus. (Cf. AER

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1/47:40.) Details of the hydraulically operated landing gear and the cockpit.

Evolution and Design of the XFD-1 Phantom. II. Kendall Perkins. *McDonnell Airscoop*, Vol. 6, No. 19, February, 1947, p. 2, illus. (Cf. AER 2/47:37.)

Origin of Species. I, II. Joseph Smith. *The Aeroplane*, Vol. 71, Nos. 1856, 1857, December 20, 27, 1946; pp. 742–747; pp. 769–772; illus. • (Extended abstract of a paper.)

A detailed account of the technical and design problems involved in the development of the Spitfire fighter. The technical details are treated in sections dealing with performance, control and stability, armament, range, structural efficiency, and special-purpose and naval modifications.

Spitfire and Seafire. J. Smith. *Flight*, Vol. 50, No. 1983, December 26, 1946, pp. 707–710, illus. (Extended abstract of a paper.) A history of design. Twenty-one design and performance characteristics of 33 models are tabulated.

Airports and Airfields

Wright Announces First Year Airport Construction Program. *U.S., Civil Aeronautics Administration, Release*, January 11, 1947. 78 pp.

A summary of the 1947 Federal Aid Airport Program, which calls for construction or improvement of 800 Class 1, 2, or 3 airports, at an estimated cost to the Federal Government of $33,899,265, with local or state governments providing an additional $37,692,600. A description of the proposed work, and a breakdown of the available funds and estimated expenditures are given for each airport.

Some Problems in Air Terminal Management. J. G. Barstow. *Western Flying*, Vol. 27, No. 1, January, 1947, pp. 28, 30, 32, illus.

A discussion of investments, the possibility of placing airports on a self-supporting basis, the need for a standard system of charges, revenue sources, landing fees, and the distribution of landing-area costs among the various types of users.

Airport Fill on Soft Bottom Controlled to Avoid Mud Waves. *Engineering News-Record*, Vol. 138, No. 4, January 23, 1947, pp. 78–81, illus.

In making a 6,000,000-cu.yd. fill at the San Francisco Municipal Airport, careful control of depth was necessary to consolidate adequately the underlying mud without building up pressures that would produce excessive mud waves. The fill, part of a $20,000,000 airport-expansion project, was placed at rates as high as 1,000,000 cu.yds. per month.

Runway Construction at London Airport (Heathrow). *Engineering News-Record*, Vol. 138, No. 2, January 9, 1947, pp. 86–90, illus.

Subsurface preparation requires the filling of old pits with compacted gravel or, when wet conditions demand, with roller-compacted concrete. The surface is 12-in. of concrete, mixed in pavers set at a central location, with wet mix hauled by truck to the forms where a mechanical spreader is followed by a tamping finisher. Full-depth expansion joints are held straight by casting an 18-in. wide strip of concrete across the lane just ahead of the general placing. Extreme mechanization and careful concrete control characterize the project.

Soil Compaction in Airport Construction. A. O. Williamson. *Airports*, Vol. 10, No. 6, December, 1946, pp. 16, 17, illus.

Planning Your Airport. I—Site Selection and Airport Layout. Eugene V. Fryhoff. *Airports*, Vol. 11, No. 1, January, 1947, pp. 24, 25, illus.

Airport Design Sketchbook. I—Terminal Vehicle Traffic Control. II—Airliner Service Station. Serge P. Petroff. *Airports*, Vols. 10, 11, Nos. 6, 1, December, 1946, January, 1947; p. 19; p. 26; diagrs.

New York Considers Major Proposals for Easing Increasing Air-Traffic Jam. *Engineering News-Record*, Vol. 138, No. 1, January 2, 1947, pp. 10, 11, illus.

The Port of New York Authority and private consultants submit programs for financing, rehabilitation, and completion of major airports in metropolitan area.

Better Business for Florida Airports. William C. Lazarus. *Southern Flight*, Vol. 27, No. 1, January, 1947, pp. 30, 31, 34. A review of the Florida Airport Management Conference, Orlando, November 25–26, 1946.

Airport Construction in Germany. *Airports & Air Transportation* (London), Vol. 1 (N.S.), No. 43, December, 1946, pp. 297, 298, illus.

The work of the Airfield Construction Service of the R.A.F. and some statistics on the operations of the British Air Force, Occupation.

Surveying the Scandinavian Airports; An Informal, First-Hand Account of Conditions, Facilities and Practices at Airports in Denmark, Sweden and Norway. Edgar Bauman. *Airports*, Vol. 10, No. 6, December, 1946, pp. 30, 31, illus.

Streamlined Hangar Design Cuts Construction, Maintenance and Overhaul Costs. Lee J. Bregenzer. *Aviation Maintenance & Operations*, Vol. 7, No. 2, January, 1947, pp. 21–23, 82, 83, diagrs.

The First Goods-Only Airport. *The Aeroplane*, Vol. 72, No. 1861, January 24, 1947, pp. 109, 110, illus.

Stansted airport, 30 miles north of London, a U.S. Army Air Forces' wartime base, has been leased by the London Aero and Motor Services and is being converted for exclusive use as an air freight base.

Sensational New Improvements in Amglo Constant Speed D.C. Motor: Improvements Based on Polarized Magnetic Drive. *Amglo Corp., Release*, Recd. December 30, 1946. 1 p., illus.

An improved model utilizes the principle of polarized magnetic drive of a vibrating reed. The new motor is intended for use in aviation signal and obstruction lights, marine beacons and buoys, time-delay controls, automatic radio transmission, and telephone interrupters.

Airport Accounting Systems. Gilbert C. Close. *Western Flying*, Vol. 27, No. 1, January, 1947, pp. 20, 21, 38, 40, figs.

Fog Dispersal. A. C. Hartley. *Airports & Air Transportation* (London), Vol. 1 (N.S.), No. 43, December, 1946, pp. 299–303, illus. (Extended abstract of a paper.)

A step-by-step review of the operations leading to the development of the Fido method of fog dispersal. The experiments and results obtained with different types of burners are described. Should a peacetime Fido installation be found desirable it would now be possible to use equipment of great flexibility of output which could be idled indefinitely whenever fog dispersal was not required, and which, with automatic selection and ignition of the burners needed to meet the meteorological conditions, would show great economies in consumption of gasoline over the wartime experiences.

Visit to Hades. *The Aeroplane*, Vol. 72, No. 1858, January 3, 1947, pp. 4, 5, illus.

History and description of the Fido fog-dispersion installation at Manston Airport, and an account of take-offs and landings made by the writers in a special demonstration.

Packaged Runway Lighting. *Airports*, Vol. 10, No. 6, December, 1946, pp. 21, 22, illus. An inexpensive lighting system for small airports is designed for ready installation and economy of operation.

New Refueling System Speeds Up Service. *Airports*, Vol. 10, No. 6, December, 1946, p. 53, illus.

Faster aircraft refueling and elimination of traffic congestion are claimed for this improved Esso refueling system installed at Moisant Airport, New Orleans.

Self-Propelled Airplane-Service Unit. *Intava Inc., Release*, Recd. January 27, 1947. 3 pp., illus.

The Intava Servicer is a mobile pumping unit for fueling airplanes, designed for use in conjunction with the airport underground pipe-line system with properly spaced hydrant valve connections. Incorporating its own fuel pump system, the unit lifts the refueling crew with their hose line to the level of the wing's edge by means of its self-contained elevator platform. Departing from the refueling system employing "tank trucks," under this plan of operation tankage can be located as close to or as far from the refueling apron as is consistent with safe flying regulations.

Airways and Traffic Control

New Instrument System Proposed for Flight and Landing Safety. Hagan L. Jackson. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 86–88, figs.

An aircraft navigation system, still in the design stage, provides three forms of aid required for safe operation of commercial and private aircraft under adverse weather conditions. The installation of a relatively simple instrument in the aircraft, together with radio-beacon transmitters on the ground and in the aircraft, provides the pilot with visual indications enabling him to make an instrument landing, to navigate cross-country, and to

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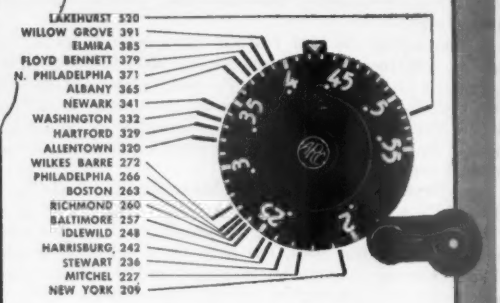

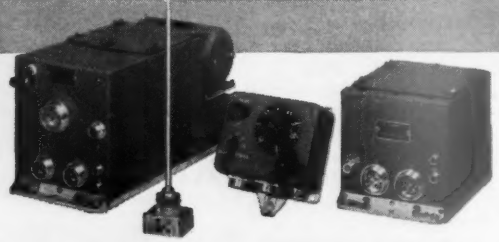

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know the disposition of adjacent planes in the air in order to proceed with safety.

Automatic Air Traffic Control Systems Will Conquer the Weather Barrier. R. E. Gillmor. *The Pegasus*, Vol. 9, No. 2, February, 1947, pp. 12–15, illus.

A review of the progress made in instrument-landing and navigation equipment, with a discussion of Ground Controlled Approach, the SCS-51 system, the Bendix PB-10, the Sperry A-12 automatic pilots, and other instruments and systems such as Teleran and Navar. Over the past 3 years the Sperry Corporation has developed a microwave localizing and landing system that is now being tried experimentally. Also on microwaves and designed to fit into their instrument-landing system, Sperry has been working on the development of a means to enable aircraft to determine automatically the direction and distance of any airport and to enable ground control stations to determine automatically the three-dimensional position of all aircraft within the control area. Recommendations are made for airport control, landing control, and airways control.

Licking "Visibility Zero." *The Martin Star*, January, 1947, pp. 12, 13, 17, illus.

Descriptions of the Instrument Landing System and Ground Controlled Approach are contained in a review of the work of the Army Air Forces, Navy Bureau of Aeronautics, and the Civil Aeronautics Administration in developing flight safeguards.

Decca System of Air Traffic Control. Dudley H. Toller-Bond. *Air Transport*, Vol. 5, No. 1, January, 1947, pp. 57, 58, illus.

Aviation—General Aspects

The State of Aviation. T. P. Wright. *Air Affairs*, Vol. 1, No. 2, December, 1946, pp. 139–151.

The development of aviation as an instrument of warfare, of commerce, and of private transportation. The potentialities of the airplane as an instrument of world peace are even greater than its services as a weapon of war. The trend toward increasing size of commercial aircraft is accompanied by increasing speeds, while greater altitude and range are contributing to the reduction of costs and rates. Improvements in performance and utilization of private aircraft are available and are being incorporated in present and future designs. Speeds approaching that of sound impose new problems in research, such as the development of jet and atomic power plants, pressurization of cabins, new wing forms, and rockets. Of equal importance are the problems of the atmosphere and means of overcoming the effects of weather conditions. Instruments for safer navigation and landing have made great progress and it is expected that the weather handicap will be eliminated within the next 5 to 10 years. Economic and political progress paralleling the technical advances will exert a profound influence on future world relationships.

Have We Been Too Optimistic? William A. M. Burden. *Flying*, Vol. 40, No. 2, February, 1947, pp. 17, 18, 97, 98, illus.

A review of aviation activities for the year 1946, discussing the expansion of the private-plane business and the reasons behind recent cutbacks, and how better planes, airports, and airways can extend gains.

Aviation and World Politics. Quincy Wright. *Air Affairs*, Vol. 1, No. 1, September, 1946, pp. 97–108.

A discussion concerning the nature of conflicting political opinions, the bearing of aviation upon world affairs, the course of recent world politics, and the possible relationship of opinion, aviation, and world politics.

Notes on Air Power in Time of Peace. John C. Cooper. *Air Affairs*, Vol. 1, No. 1, September, 1946, pp. 80–96.

The principal conditions and elements which, during peace, contribute to or limit the air power available to a nation for its national civil and military objectives are outlined as geographical conditions, resources, population, industrial development, and political conditions. Each of these elements is analyzed and evaluated with respect to its bearing upon the progress of civil aviation and to the development of adequate military air power.

Aviation and Society. William Fielding Ogburn. *Air Affairs*, Vol. 1, No. 1, September, 1946, pp. 10–20.

The influence of early advances in technology upon the progress of civilization is traced as evidence of the further progress to be expected from continued development of air transportation. Economic, cultural, and political advancement has always followed scientific progress, especially in the field of transportation. Because of its ability to overcome the barriers of time, distance, and terrain, air transportation is regarded as perhaps the greatest single influence in the forward march of society.

Atomic Energy, Aviation, and Society. Harold C. Urey. *Air Affairs*, Vol. 1, No. 1, September, 1946, pp. 21–29.

It is difficult to ascribe to any discovery or invention of historic times an importance comparable to that of the invention of the airplane and the discovery of atomic energy. Corresponding discoveries of prehistoric times, such as fire, the boat, and the wheel, are the basis of all mechanical and technical progress, and have exerted a profound influence on the life of mankind. Because of the far greater speed and freedom of movement achieved by the airplane, and the factor of 3,000,000 in the amount of energy to be obtained from equal masses of matter by atomic means, it is expected that those inventions will influence the present civilization as greatly as prehistoric inventions changed the mode of life of primitive man. Since the development of atomic energy for both destructive and peaceful purposes may be as rapid as that of the airplane, it is imperative that means be found to control and regulate the use of that power, to prevent the total destruction of civilization.

Air Power and Peace. Eugene E. Wilson. *Air Affairs*, Vol. 1, No. 2, December, 1946, pp. 178–183.

Air power parallels sea power as a decisive element in war, but both are more important as instruments of trade and in the maintenance of peace. Both terms encompass much wider fields than are indicated in war uses alone, since a nation's air power means its air commerce and its production of the aircraft and equipment needed for peace as well as for war. Solution of the problems of development and regulation of air transportation can be a decisive factor in the maintenance of world peace, and to that end it is recommended that an impartial Air Policy Board be appointed, composed of men not connected with aviation or the armed services, to reconcile conflicting interests and end jurisdictional disputes.

The Old Year: Record Flights and Great Expectations; Technical Preparation for Tomorrow; Air Transport Is Nationalized. *Flight*, Vol. 51, No. 1984, January 2, 1947, pp. 11–17, illus. A review.

1946—A Year of Transition. *The Aeroplane*, Vol. 72, No. 1858, January 3, 1947, pp. 21, 22. A review of developments in aircraft and engine design.

Business and Finance

Aviation Prospects Uncertain in '47: Important Policy Decisions Lie Ahead for Airlines; CAB Faces Busy Year; Upturn in Military Production Expected. *American Aviation*, Vol. 10, No. 15, January 1, 1947, pp. 13, 14.

The Aircraft Industry—1946–47; A Year-End Roundup. *Aircraft Industries Assn. of America, Inc., P.R. Release No. 267*, December 31, 1946. 6 pp. (Cf. AER 2/47:41.)

Surplus Plane Disposal. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 97, 216. (Cf. AER 2/47:41.)

Comfort in Aircraft

Noise Reduction in Aircraft. H. Wayne Rudmose and Leo L. Beranek. *Journal of the Aeronautical Sciences*, Vol. 14, No. 2, February, 1947, pp. 79–96, figs. 3 references.

A complete treatment of the sources of noise in aircraft, the calculation or estimation of their intensities, and means for applying acoustical treatment are given. The principal sources of noise are the propellers, aerodynamic turbulence, the exhausts, engine vibration, and sources such as wind leaks, ventilators, loose ash trays, etc. The noise levels produced by the propellers in the lower frequency bands (35–150 cycles per sec.) can be computed from flight data. Having the propeller noise, the shape of the remainder of the sound spectrum outside the airplane can be estimated. By taking into account the acoustical properties of the bounding surfaces of the cabin undergoing treatment and the calculated noise spectrum outside the airplane, the average sound level in the cabin is determined. The method permits the detection of areas of the cabin which are weak acoustically and reveals ways to use the acoustical treatment efficiently. A practical example is carried through to illustrate the procedure.

The Consolidated Vultee XB-46 experimental jet bomber being built for Army Air Forces is powered by four General Electric turbojet engines.

Ambient Comfort. *Flight*, Vol. 50, No. 1982, December 19, 1946, pp. 668–670, diagrs.

A combined humidifying and drying device for cabin air conditioning, developed by Sir George Godfrey and Partners, Ltd., in collaboration with Birlec, Ltd., in England, is designed to provide complete air conditioning under widely varying climatic conditions. Essentially the scheme consists of the interposition in the system of "wetter" and/or "drier" units through which the inducted air is passed on delivery into the fuselage.

Plane Climate Comfort. George R. Wallen. *Western Flying*, Vol. 27, No. 1, January, 1947, pp. 34, 37, illus.

Efficient air distribution in the cabin of an aircraft requires that the incoming air from ducts be mixed with existing cabin air well out of the breathing area of the occupants. The Anemostat air-diffuser for accomplishing this is described.

Practical Problems in Reducing Noise in Personal Planes; Engine and Airframe Aspect. B. J. Simons. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 3 pp. The various means of noise reduction used in the Stinson Voyager 150.

Control Systems

Lateral-Control Characteristics of Various Spoiler Arrangements as Measured in Flight. J. Richard Spahr. *U.S., N.A.C.A., Technical Note No. 1123*, January, 1947. 53 pp., illus. 15 references.

The spoilers were located near the wing trailing edge. It was found that, in all cases, the control response was satisfactory and that, except for a region of low spoiler effectiveness for small control deflections, the variation of rolling effectiveness with control deflection was smooth and nearly linear. The rolling effectiveness for a given spoiler deflection was found to increase with air speed. The control forces varied smoothly but at an increasing rate with control deflection, leading to a low degree of control feel for small spoiler deflections. With a system that consisted of spoilers in combination with small wing-tip ailerons, the effectiveness and control-force characteristics were exceptionally good, especially at high speeds. The yawing characteristics of the various spoiler arrangements were more favorable than those usually associated with aileron control, and the lateral control in inverted flight was adequate.

Flight Tests of an All-Movable Horizontal Tail with Geared Unbalancing Tabs on the Curtiss XP-42 Airplane. Harold F. Kleckner. *U.S., N.A.C.A., Technical Note No. 1139*, October 1946. 46 pp., figs. 10 references.

After previous tests had shown that with servotab and bobweight the pilot's stick forces were too light for rapid maneuvers, the pilot's stick was connected directly to the tail and the tabs were changed from servotabs to geared unbalancing tabs. With an all-movable tail reduced in area 35 per cent below that of the conventional fixed-stabilizer tail, the airplane would have satisfactory characteristics over the same total c.g. range, but the range would extend from 15 to 23 per cent instead of from 22 to 30 per cent mean aerodynamic chord for the conventional fixed-stabilizer tail. At Mach Numbers near unity the all-movable tail will require a power boost control that could be adapted as well to a movable stabilizer. The reduction in tail size obtainable with an all-movable tail, however, would be expected to improve elevator control characteristics for this high-speed range.

Unified Symbolism for Regulatory Controls. G. A. Philbrick. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 1, January, 1947, pp. 47–58, Discussion, pp. 59–67, figs.

In a reconstruction of the fundamentals of automatic regulation, proposals for symbolism are made. The basic null-seeker or follower is presented as a primary mechanism about which the symbolic and terminological structures of the subject may be centered. There is also included a brief treatment of the relationship between the viewpoints of transient phenomena and steady oscillations, where these are concerned with a study of the dynamics of regulatory process.

Purdy Quick Disconnect. *Durham Aircraft Service, Inc., Release*, Recd. January 6, 1947. 2 pp., illus.

Designed for the quick disconnection of control rods, the Purdy unit has been tested for performance under a 25-lb. continuous rigging load and a 150-lb. operating load. Opened or closed by a finger twist of the locking collar, the fitting eliminates the operations of removing clevis pins, bolts, nuts, and locking wire, and enables faster readjustment of control-rod length. Six models are available, incorporating three styles of ends.

Directories

1947 Annual Index of Airframe and Powerplant Manufacturers. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 141, 143, 145, 147.

An alphabetical listing of over 130 companies, giving addresses and the names of key personnel.

1947 Directory of Aircraft and Powerplant Accessories and Parts. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 152–154, 156, 158, 160, 162, 164. Company names are listed under 73 main and 130 subclassifications.

1947 Annual Index of Manufacturers of Aircraft Accessories and Parts. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 168 ff. (13 pp.) An alphabetical listing of over 525 companies giving addresses and the names of key personnel.

Education, Training, and Occupations

Education for an Air World. Paul R. Hanna. *Air Affairs*, Vol. 1, No. 2, December, 1946, pp. 152–164.

Education, economics, and spiritual progress have not kept pace with the advances of technology and science. School curricula should be revised and expanded to fit the coming generations for the conditions they will encounter in a world where scientific progress has broken down the barriers of time and distance. Knowledge of geography, history, civics, economics, biology, and the physical sciences should be brought up to date, and teaching methods should be expanded to encompass the global point of view. Such a goal requires long-range planning on the broadest possible basis.

Technical Problems of Film Production for the Navy's Special Training Devices. H. S. Monroe. *Society of Motion Picture Engineers, Journal*, Vol. 47, No. 6, December, 1946, pp. 487–493. 1 reference.

Tennessee's Institute of Aviation. *Tennessee Air Progress*, Vol. 1, No. 4, Winter, 1947, pp. 16–18, illus.

Training 'Em Right in Peru. George M. Galster. *The Pegasus*, Vol. 9, No. 1, January, 1947, pp. 14–16, illus. Notes on the Peruvian air force training school and the national aircraft factory near Lima.

Technical Education—AAF Style (A.A.F. Institute of Technology, Wright Field, Dayton, O.). *The Pegasus*, Vol. 9, No. 1, January, 1947, pp. 1–5, 16, illus.

Flying Executive—The Pilot. Dan Gerber. *Skyways*, Vol. 6, No. 2, February, 1947, pp. 38, 39, 80, illus. Company-owned planes provide a new employment opportunity for the pilot. The requirements for such a pilot are outlined.

Electrical Equipment

Altitude Rating of Electric Apparatus. Paul Lebenbaum, Jr. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. W-40)*, January, 1943. 26 pp., figs. 1 reference.

Electric Motors for Aircraft. T. B. Holliday. *Product Engineering*, Vol. 18, No. 1, January, 1947, pp. 86—90, illus.

The mechanical and operational characteristics of electric motors are compared with those of hydraulic and pneumatic equipment for actuating the controls. The trend toward the use of high-frequency a.c. motors for certain applications is noted, and some of the limitations of the electric motor are stated. Five types of motor application in aircraft are described. Definite advantages of electric motors for aircraft are their relatively low cost and their reliability. Their relatively high weight is more than compensated for by low competitive weight of electric wiring, especially in the higher voltage systems.

Ledex Rotary Solenoids and Rectifiers. *George H. Leland, Inc., Release*, December 16, 1946. 34 pp., figs.

Two basic designs of Ledex solenoids in $1^7/_8$-in. and $2^1/_4$-in. diameters were recently developed to serve as an economical means of converting a.c. to d.c. for operating solenoids from an a.c. source. The various applications of solenoids, specifications, prices, drawings, and power graphs are included.

Electric and Electronic Functions Reliable Nerve System of DC-4M. D. R. Taylor. *Canadian Aviation*, Vol. 20, No. 1, January, 1947, pp. 49, 62, 74, 76, illus.

The functions of the electric and electronic equipment are listed. Details are given about the instrumentation, radio system, and electric system.

Why Airliners Should Have Fluorescent Lighting. R. A. Rugge. *SAE Journal*, Vol. 55, No. 1, January, 1947, pp. 52, 53, illus. (Abstract of a paper: Fluorescent Lighting for Commercial Airplane Interiors.)

Engine Parts and Accessories

Effect of High Speed Fueling on Aircraft Design. Eric Olsen. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 37 of this issue, March, 1947.)

N.A.C.A. Study of Measurement of Piston-Ring Radial-Pressure Distribution. Milton C. Shaw, Charles D. Strang, and Ormal W. Hart. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 43 pp., figs. 15 references.

An investigation using a multipoint radial-force-measuring gage led to the following conclusions: (1) It was found necessary to position the adjacent load-measuring elements radially to within less than 0.0001 in. if reasonable accuracy is to be achieved. (2) An equal increase of as much as 0.001 in. in the radial setting of all load-measuring units had little effect upon the radial-force distribution. (3) A cylinder that is out of round by as little as 0.005 in. is capable of significantly affecting the radial-pressure pattern. (4) Twelve equally spaced load-measuring elements were found to be sufficient to determine discrepancies in a ring of good quality. (5) A piston ring exhibiting uniform radial pressure will not necessarily exert equal forces when compressed to cylinder diameter at a finite number of points. (6) The radial-force distribution of both cast-iron and steel piston rings varied with the strain history of the ring.

Fuel Metering by Engine Speed and Manifold Density. Jay A. Bolt. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 23 pp., figs. 9 references.

An examination is made of the problems and desirability of metering fuel to an engine as a function of the major variables that directly indicate engine air consumption. A device that performs this function is described in detail. It has been applied to aircraft engines with continuous induction system injection, to engines with timed cylinder injection, and to gas-turbine jet engines. In this system the engine itself is used as an air meter in place of the standard carburetor venturi system. The history of the subject is briefly reviewed and details are given about the design, principles of operation, and performance characteristics of the Bendix speed-density metering unit.

Crankshaft Bending Vibration. E. Forest Critchlow and W. T. Bean, Jr. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 18 pp., figs. 3 references.

Studies of crankshaft failures show that they may result from either forced or resonant bending vibration. An analysis was made of a typical bending failure in the crankshaft of a six-cylinder opposed aircraft engine, resulting from forced vibration, and a typical bending failure in a seven-cylinder radial crankshaft, resulting from resonant vibration. Both systems were investigated analytically as well as experimentally and good agreement was achieved. A detailed account is presented of the mathematical calculations and the experimental methods developed.

Analyses of High-Speed Crankshaft Loads. II. J. E. Binding. *Aircraft Engineering*, Vol. 18, No. 214, December, 1946, pp. 408–412, figs. (Cf. AER 2/47:42.)

A detailed study is made of the dynamics of the articulated connecting rod of radial engines. The inertia forces in an articulated connecting-rod system are treated in a manner similar to that applied to the ordinary crank mechanism, that is, by replacing the rods with their appropriate end-to-end weights and introducing suitable correcting moments. It is found convenient to resolve the various forces acting on the crankpin into their radial and tangential components, employing an appropriate sign convention. An accurate treatment for the reactions at the main bearings and the bending moments at various sections in the crankshaft is provided by the concept of strain-energy, whereby the distortion of the crank webs, which may be considerable in a radial engine, is taken into account.

Plywood Drop Tanks. F. A. Dale. *Australia, Council for Scientific and Industrial Research, Division of Aeronautics, Report No. SM. 70*, July, 1946. 31 pp., illus. 4 references.

Droppable fuel tanks made of synthetic resin or casein bonded plywood, assembled with casein glue, were used instead of metal auxiliary tanks for military aircraft. They gave satisfactory service except in certain parts of the tropics where extreme climatic conditions prevailed. Being lighter than metal tanks of corresponding size, they were more easily handled and installed, less subject to damage, easier to repair, and rendered acceptable service from the operational standpoint when properly installed on the airplane with suitable mechanisms for release.

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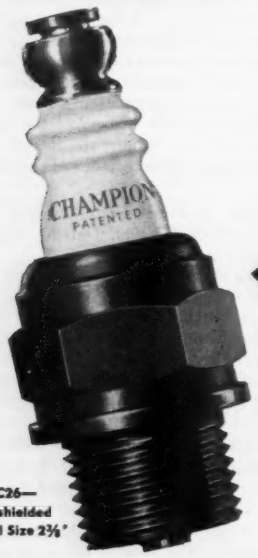

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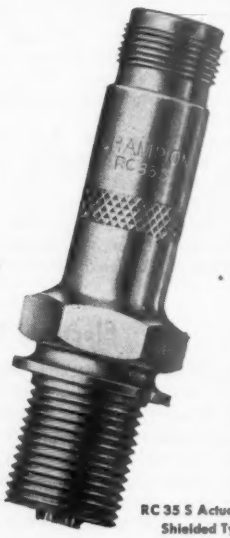

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Welded Magnesium Tanks. I—Design Considerations: Comparison of Materials: Testing Large Tanks. R. J. Cross. *Aircraft Production*, Vol. 9, No. 99, January, 1947, pp. 28–33, illus.

Design Technique Forecasts Supercharger Performance. R. J. S. Pigott. *SAE Journal*, Vol. 55, No. 1, January, 1947, pp. 59–64, figs. (Extended abstract of a paper: "Analysis of Positive Supercharger Losses.")

The performance of positive-displacement compressors is predicted by the use of analytical methods developed to define and calculate losses. Mechanical and slip losses are broken down and formulas for calculating them are presented. A complete discussion is given to oil losses for common ball and roller-bearing configurations, including the influence of operating temperature of the lubricant and deformation of metal on bearing losses. Both the Roots and vane types of compressors are analyzed, as well as a number of component designs.

Stratos Design Enhances Air Safety. *Stratos Corp., Release*, Recd. February 3, 1947. 1 p.

A simple control, operated through a push button on the instrument panel, provides for the immediate disengagement of any of the engine-driven aircraft accessories at the first symptom of malfunctioning, without damaging either the accessory or the engine. This quick-disconnect coupling has been incorporated into the Stratos Corporation's line of aircraft-pressurization and air-conditioning equipment, and will soon be available to accessory manufacturers.

Valve Gear Problems. M. C. Turkish. *The Oscillographer*, Vol. 8, No. 1, January-February, 1946, pp. 1–4, figs.

The equipment used for the study of valve-gear motion consists of a magnetic pickup, an electrical network, a cathode-ray oscillograph, and a synchronization trip. A permanent magnet, attached to the poppet valve, moves within a coil of wire rigidly mounted on the engine frame and generates a voltage proportional to the valve velocity. The oscillograph will show a valve-velocity curve when connected directly to the pickup, and a valve-lift or valve-acceleration curve when a suitable electrical network is inserted in the circuit.

An Ingenious Fuel Cock. *The Aeroplane*, Vol. 72, No. 1860, January 17, 1947, p. 86, diagr.

An electric fuel valve developed by Miles Aircraft, Ltd., offers a large reduction in weight through the elimination of mechanical controls. Provision is made for the automatic cutoff of the fuel supply in case of fire, and for the change of connections to the reserve tank when the main fuel tank is empty.

New 14 Oz. Non-Pulsating Fuel Pump for Light Planes. *Romec Pump Co., Release*, December 23, 1946. 1 p., illus.

The Romec vane-type nonpulsating fuel pump for light aircraft weighs 14 oz., and is available with various drive couplings and mounting flanges. It has a capacity of 75 gal. per hour, and a speed range to 4,000 r.p.m. It operates at pressures up to 60 lbs. per sq.in.

Sliding Gate Shut-Off Valves. *Wm. R. Whittaker Co., Ltd., Release*, Recd. January 7, 1947. 3 pp., illus.

The valve consists basically of two ported metal face plates between which a metal slide operates. The Whittaker fluid seal eliminates metal-to-metal contact between the moving and stationary parts. The valves are manufactured in a wide variety of types, sizes, and pressure ratings to meet the requirements of all aircraft installations. They are suitable for fuel, oil, water, air, or vacuum lines, and are readily adapted to remote control systems.

Engines—General

Aircraft Propulsion. F. M. Green and J. E. Wallington. *The Engineer*, Vol. 182, No. 4743, December 6, 1946, pp. 516, 517, diagr., Discussion, pp. 521, 522. (Extended abstract of a paper.)

An analysis is made of the power efficiency and specific fuel consumption of modern piston and gas-turbine engines, and the relationship between engine performance and aircraft performance. Much improvement in the weight per cruising horsepower and thermal efficiency of the piston engine is unlikely because of compression-ratio limitations. At the compression ratios used, modern engines of 5- to 6-in. bore have about the same indicated thermal efficiency, work at nearly the same mixture strength, and have a nearly constant volumetric efficiency over the working range. The performance characteristics of a particular engine are calculated and the results are applied to the study of the performance of a typical air liner. The efficiency of turbine power plants of the simple jet and jet-engine-propeller types, and the performance of airplanes provided with these types are examined. It is concluded that piston engines will disappear except for small airplanes; jet propulsion will be used for military aircraft; passenger planes will use turbine-propeller units, and later, jet turbines for more than 500 m.p.h. and propulsion ducts for more than 1,000 m.p.h.

Suiting the Power Plant to the Aircraft. *De Havilland Gazette*, No. 35, October, 1946, pp. 2–4, illus. (Extract from *L'Aérophile* (Paris).)

The suitability of the various types of gas-turbine power plants, ram-jet units, and rockets for military or commercial aircraft is compared. Turbine-propeller combinations are considered advantageous for present transport aircraft. The simple turbojet is expected to take a prominent place in the higher speed and greater altitude ranges visualized for transport operations and is likely to be predominant in military craft of the immediate and longer future. The ducted-fan unit has possibilities of use in flying boats and elsewhere, or in combination with propeller or jet power plants. Ram-jet and rocket engines are predicted for military service and space exploration in the outer reaches of the atmosphere. For small transports the propeller is expected to remain supreme, with either piston engines or turbines for power, and the piston engine-propeller drive appears to be certain for personal aircraft.

Engines—Today and Beyond. Arthur Nutt. *Aero Digest*, Vol. 54, No. 1, January, 1947, p. 105, illus.

Although the war years produced no radical changes in reciprocating engines, great increases in power have been achieved through the use of better fuels, superchargers, water injection, fan cooling, and direct fuel injection. No revolution in engine design is expected in the near future, but progress will be made in gas turbines, pulse-jets, ram-jets, and rockets.

New Horizons in British Aviation. II. Ronald A. Keith. *Canadian Aviation*, Vol. 20, No. 1, January, 1947, pp. 34, 35, illus.

The influence of gas-turbine power plants on future developments is considered. The performance characteristics of the pure jet turbine, the propeller turbine, and reciprocating engine are examined and compared, as well as their influence on aircraft performance. The flight characteristics of jet aircraft and the use of the Mach meter for recording the speed of high-speed aircraft are briefly discussed.

Transport Aircraft Powerplant Outlook for 1947. R. C. Loomis. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 4 pp.

A survey of improved types of reciprocating engines which are being applied to the newer types of commercial transport aircraft, and a forecast of the prospects for gas-turbine-propeller and turbojet power plants for commercial operations during the next few years. The use of fuel injection, water injection, exhaust-turbosuperchargers, and improved cylinder cooling methods also is discussed.

Power Installations. II. F. M. Owner. *Flight*, Vol. 50, No. 1981, December 12, 1946, pp. 655–657. (Extended abstract of a paper.) (Cf. AER 2/47:43.)

Air at 70 Degrees Below Zero for Engines on Test. *United Aircraft Corp., Pratt & Whitney Aircraft Div., Release*, February, 3, 1947. 2 pp.

Equipment to be installed in a new dynamometer and refrigeration building will enable extensive development work on more powerful highly supercharged engines for high-altitude flying. The building will be equipped with two 5,000-hp. electrical dynamometers and electrically driven refrigeration compressors delivering a total of 1,500 hp. A liquid, cooled to −80°F., will be piped from the refrigerating units to air-cooling coils from which air will be fed to the engines on test at temperatures as low as −70°F. There will be available 150,000 lbs. of refrigerated air per hour.

High-Altitude Aircraft-Engine Test Plant. W. Spillmann. (*Flugwehr und -Technik*, Vol. 8, Nos. 4, 5, April-May, 1946, pp. 97–100, 128.) *The Engineers' Digest*, Vol. 3, No. 12, December, 1946, pp. 617–619, figs. (Abstract.) Designed and built by the Brown Boveri Co. for the Swiss military authorities, it was put into service in 1944.

Big Process Refrigeration Installation Used in Research on Aircraft Engines. *Heating, Piping & Air Conditioning*, Vol. 18, No. 12, December, 1946, pp. 113, 114, illus.

The refrigeration equipment installed at the N.A.C.A. Aircraft-Engine Laboratory, Cleveland, provides temperatures from −48°F. to above 130°F. Wind velocities up to 500 m.p.h. and

pressures simulating altitudes up to 50,000 ft. can be produced in the laboratory.

Engines, Gas Turbine

Performance Charts for the Turbojet Engine. Benjamin Pinkel and Irving M. Karp. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 37 of this issue, March, 1947.)

Tensile Properties of a Sillimanite Refractory at Elevated Temperatures. Alfred E. Kunen, Frederick J. Hartwig, and Joseph R. Bressman. *U.S., N.A.C.A., Technical Note No. 1165*, November, 1946. 22 pp., figs. 12 references.

The tensile strength, the stress-to-rupture characteristics, and the modulus of elasticity of a sillimanite refractory material for gas-turbine blades were investigated at various temperatures. The tensile strength varied from a minimum of 8,000 lbs. per sq.-in. at a temperature of 500°F. to a maximum of 19,000 lbs. per sq.in. at 1,800°F. The strength at 1,950°F. was approximately 15,000 lbs. per sq.in. Heat-treating the tensile specimens for ½ hour at 1,800°F. increased the tensile strength 35 per cent at room temperature and 70 per cent at 500°F. No increase in strength was noted at or above 1,400°F. At a temperature of 1,600°F., the 100-hour rupture strength was 9,600 lbs. per sq.in. and the 1,000-hour rupture strength was 8,500 lbs. per sq.in. At 1,800°F., the material withstood a stress of 6,700 lbs. per sq.in. for 19 hours. The modulus of elasticity, which was determined only at room temperature, was 20.3×10^6 lbs. per sq.in. and the material was elastic to the point of fracture. The density of the sillimanite refractory was 0.10 lb. per cu.in., or approximately one-third that of high-temperature metal alloys.

100-Hour Endurance Test of Rolls-Royce Derwent V. *Rolls-Royce Ltd., Release*, Recd. January 31, 1947. 2 pp. (Cf. AER 1/46:63.)

The aim of the test was to obtain production clearance for alternative turbine blade materials, and to get running experience of the use of fuel without the addition of lubricating oil. Forty-three hours running was done at 3,000 lbs. thrust, 20 hours at 3,500 lbs., and the remaining 37 hours at thrusts varying from 3,000 lbs. to 500 lbs. At the start of the test, performance curves were plotted for comparison with curves taken after the tenth and twentieth 5-hour cycles. The loss in engine performance at the end of the tenth cycle was less than 1 per cent of the maximum thrust, and at the end of the twentieth cycle only 1.43 per cent of the maximum thrust. To prove that the safety factor of the turbine wheel is unimpaired after prolonged periods of running, the engine speed was increased 3 per cent above the standard combat r.p.m., the actual speed being 15,150 r.p.m. Four of these overspeed tests were completed on the test run and the engine showed no ill effects.

Stresses in Rotating Discs by Radius of Curvature Integration. C. M. McDowell. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 8 pp., figs. 3 references.

In analyzing the stresses in a rotating disc such as a turbine wheel, the important factors are the radial and tangential stresses. Several methods of determining them are in use, of which three are (a) the mathematical method, requiring the solution of simultaneous equations of equilibrium, which is laborious; (b) the method of small differences; and (c) Donath's method. The differential equation expressing the stresses set up by centrifugal forces can also be solved by the "radius of curvature" method, of which a detailed explanation is given. The method involves trial calculations ranging in number from one to eight, with an average of three trials generally resulting in a satisfactory solution.

Mean Specific Heats for the Working Media of Gas Turbine Powerplants. Newman A. Hall. (United Aircraft Corp., Research Dept., Report No. R-2000-2.) *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 18 pp., figs. 5 references.

The analytic accuracy necessary in the thermodynamic analysis of the action of the working medium of gas-turbine and jet propulsion systems has been obtained in most cases by the proper introduction of enthalpy, entropy, internal energy, and other thermodynamic quantities as given by extensive tables and graphs. A method of using mean specific heats to calculate the thermodynamic characteristics of the working media is developed. As the working medium in most cases is almost entirely air, charts are presented giving the mean specific heats for air together with correction factors to account for the presence of water vapor, fuel vapor, and products of combustion. Several examples show the application of the method to practical problems.

The Development of an Axial Flow Gas Turbine for Jet Propulsion. I. D. M. Smith. *The Engineer*, Vol. 183, No. 4749, January 17, 1947, pp. 81, 82, illus. (Extended abstract of a paper.)

A review of the development work on gas turbines carried out by the Metropolitan-Vickers Electrical Co., Ltd., is concerned with engines operated on the simple cycle of compression, continuous combustion, expansion through a turbine, and discharge through an exhaust nozzle. The multistage axial flow compressors involved design problems which are described. A short description is given of a recent engine, the F 2/4, and the development of its component parts.

Study of Fuel Systems for Jet Aircraft. W. H. Curtis and P. J. Lansing. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 16 pp., figs.

Fuel systems for gas-turbine and jet power plants comprise two principal sections: (1) the air-frame system, consisting of fuel tanks, piping, valves, and booster pumps; and (2) the engine system, including filters, control units, engine-driven main fuel pump, flow dividers, and fuel nozzles. In addition to the usual minimum requirements (continuous flow, predetermined order of flow from auxiliary tankage, booster-pump equipment, emergency fuel feed, provision for steady flow in any attitude of the airplane, and automatic air shut-off valves for tanks emptied or dropped), it is suggested that further provisions be made for emergency operation. These include automatic means for establishing emergency fuel feed in event of failure of main tank booster pumps and in event of damage to the main engine service tanks. Details are given about the filters, fuel pumps, control equipment for speed, temperature, and fuel pressure, flow dividers, and nozzles included in the engine fuel system. Comparisons are made with various German and British fuel systems. Simplicity and accessibility are urged.

Installation of Jet Turbines. M. C. Benedict and A. W. Gabriel. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 136–139, illus.

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The small frontal area and the cylindric form of the gas turbine are favorable factors in the solution of the problems of installation in "aerodynamically clean" airplanes, making it possible to select the most suitable position either within the fuselage, at the wing roots, or in nacelles. Vibration loads are small and at frequencies above those of the mounting system and structure, simplifying the mounting and cowling design. It is recommended that a butterfly valve be installed in the inlet air duct to prevent the ram air from "windmilling" the engine. Suggestions are made for the layout of the fuel and lubrication systems, instrumentation, electrical system, and the accessories.

The Atmosphere and Its Predicted Effects on Turbine Type Aircraft Engines. A. Dolinsky and F. W. Disch. *Preprint, S.A.E. Annual Meeting,* Detroit, January 6–10, 1947. 22 pp., figs. 5 references.

The effects upon the efficiency of gas turbines and compressors of atmospheric changes and what may be termed impurities in the air are studied with regard to temperature, humidity, water ingestion, and deposits of dust, dirt, or oil films on blades. Changes of thrust, power, and fuel consumption as a result of these effects are computed theoretically, and means of excluding foreign matter from the engine air stream are suggested. External or internal inertia-type separators appear to be the simplest solution of the icing problem. Power, thrust, and overall thermal efficiency of gas turbines are more largely affected by ambient air temperatures than is the case with reciprocating engines; high humidity apparently has a negligible influence on gas turbines as contrasted with piston engines; ingested water, such as heavy rain concentration, will effect large power increases in gas turbines that are controlled by speed and combustion temperature without power-limitation devices; abrasive, erosive, or contaminating matter in the engine air stream can cause depreciation in turbine power in a ratio as high as four times the percentage decline in efficiency due to blade-contour changes and clearances.

Aircraft Propulsion: Net Thrust Horsepower as a Basis: Progress in Power/Weight Ratio and Thermal Efficiency: The Discussion: Ceramic Materials Suggested for Turbines. F. M. Green and J. E. Wallington. *Flight,* Vol. 50, No. 1981, December 12, 1946, pp. 648–650, figs. (Extended abstract of a paper.)

Aircraft Propulsion. Discussion. I, II. F. M. Green and J. E. Wallington. *Engineering,* Vol. 162, Nos. 4222, 4223, December 13, 20, 1946; pp. 570, 571; pp. 593, 594. (Cf. preceding abstract.)

Optimum Blade Pitch for Turbo-Machines with Special Reference to Blades of Great Curvature. II. O. Zweifel. (*Brown Boveri Mitteilungen,* Vol. 32, No. 12, December, 1945, pp. 436–444.) *The Engineers' Digest,* Vol. 3, No. 12, December, 1946, pp. 601–603, figs. (Cf. AER 2/47:46.) (An abridged translation.)

Stressing of Gas Turbine Blading. J. Hodge. *The Engineer,* Vol. 182, No. 4745, December 20, 1946, pp. 559, 560, figs.

The methods described have given reliable results in practice, and while all the factors involved are not fully taken into account, the most important can be accurately calculated. These consist of the pure centrifugal tension, the centrifugal bending stress, and the bending stress due to the gas loading. By consideration of these a reasonable compromise can be arrived at between aerodynamic shape and structural strength.

Pneumatic Fatigue Testing. F. B. Quinlan. *Automotive and Aviation Industries,* Vol. 96, No. 2, January 15, 1947, pp. 30, 31, 94, 96, illus.

In turbosuperchargers and jet engines, bucket vibrations are stimulated by pulsations in the gas chamber between the heater and the nozzles. The buckets are also subjected to periodic disturbing forces as they pass through regions of alternately high and low gas pressures. In the fatigue-testing machine, for reversed bending, a pulsating air stream is used to reproduce these pulsations. The device consists of a tuned air column in which the tuning is accomplished by decreasing or increasing the length of the air path.

Power Units for Future Aircraft. F. R. Banks. *The Royal Aeronautical Society, Journal,* Vol. 51, No. 433, January, 1947, pp. 35–53, illus. (Cf. AER 2/47:46.)

Metrovick F.5. *Flight,* Vol. 51, No. 1984, January 2, 1947, p. 18, illus. Some further details about the open-fan thrust augmenter used on the Metropolitan-Vickers F.5 gas turbine.

Blade Design Data for Axial-Flow Fans and Compressors. Seymour M. Bogdonoff and Harriet E. Bogdonoff. *U.S., N.A.C.A., Advance Confidential Report No. L5FO7a (Wartime Report No. L-635),* July, 1945. 65 pp., figs. 3 references.

Engines, Ram-Jet

Investigation on the Suitability of Solid Propellants for Ram-jets. H. Schwabl. (*ZWB/UM/2852,* January, 1945.) *U.S., Army Air Forces, Translation No. F-TS-1021-RE,* December, 1946. 32 pp., figs.

Tests were made with model engines on the application of finely powdered hard or soft coal as propellants for ram-jets. Jet performance data are developed and results are shown graphically. Several designs for combustion chambers serving as fuel containers have been investigated. Later tests were made with oxygen-charged coal as fuel. Results showed that solid fuels can be used with some success.

Forecast: Fruitful Future for Jet. L. B. Edelman. *SAE Journal,* Vol. 55, No. 1, January, 1947, p. 43, diagr. (Abstract of a paper: "The Evolution of the Pulsating Jet Engine and Its Future Prospects.")

Engines, Reciprocating

High Altitude Development of Engines. B. G. Markham. *Aeronautics,* Vol. 15, No. 6, January, 1947, pp. 64, 67, 68, 71, 72, 75, illus.

Particular attention is given to problems of supercharger design, although oil system, propeller, and ignition requirements also are discussed. Results of considerable investigation and practical experience indicate that the commercial transport engine for operation at heights of 25,000 to 30,000 ft. should be of relatively simple and straightforward design. By careful attention to detail it is possible to obtain a rated altitude of up to about 27,000 ft at cruising power with a single-stage supercharger. This is equivalent to about 29,000 ft. if allowance is made for ram pressure on the air intake. With a blower of this type, it is not considered that the complication of turbosuperchargers or two-stage blowers is justifiable.

Cold Weather Operation of Aircraft Power Plants by the United States Navy. A. K. Forney. *Preprint, S.A.E. Annual Meeting,* Detroit, January 6–10, 1947. 5 pp.

Extensive tests of cold-engine starting have shown that the direct-cranking speeds of aircraft-engine starters can be reduced from approximately 60 r.p.m. to about 25 r.p.m., thereby obtaining longer cranking periods from a given battery capacity, lower voltage requirements, and less starter weight. The development of batteries having increased capacity at high discharge rates would eliminate the use of the portable auxiliary power units and external charging equipment being used on aircraft carriers. The problems of engine heating, spark-plug icing, oil dilution, and priming still await final solution. Carburetor-induction icing was corrected by the use of the "alternate-air" system, by which the flow of induction air can be shifted from the air scoops when icing conditions threaten, to let the air be taken from a protected position, usually behind the cylinders, where it is slightly heated and freed from moisture.

Aircraft Engine Starting Tests and Experiences in the Arctic. William Weitzen and Robert G. Dunn. *Preprint, S.A.E. Annual Meeting,* Detroit, January 6–10, 1947. 14 pp., figs. 7 references.

The question is divided into four major phases summarized as (1) the present minimum cold-starting temperature limits using regular AN-F-28 gasoline and standard priming systems; (2) reasons for the limit determined; (3) temperature to which the existing limit can be lowered using regular gasoline and improved priming systems; and (4) special equipment and special starting fuels required to accomplish quick starts at the proposed new minimum temperature. Limits of 0 to −10°F. are set for radial engines with pressure-type carburetors and −10 to −15°F. for in-line engines and radial engines with direct injection. Unsatisfactory priming systems, poor technique, and improper oil dilution are principally responsible for the present limits, but with better atomization and improvements in other directions satisfactory starts should be attainable at −35°F. Development of special equipment and fuels should reduce the minimum limit to −65°F.

Recent Developments in Thrust Augmentation as Applied to Radial Engine Installations. William A. Clegern. *Preprint, S.A.E. Annual Meeting,* Detroit, January 6–10, 1947. 31 pp., illus.

Consolidated Vultee Aircraft Corporation has developed an exhaust ejector for radial-engine installation, using the exhaust

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energy to pump cooling air. It eliminates cowl flaps, decreases the form drag, overcomes cooling drag, and adds to the thrust. The device is a combination suction pump, thrust augmenter, pressure ejector, muffler, and hot-air pump. Details are given about the evolution of the design by means of test-stand experiments and scale models of the Model 110 airplane, leading to the final form of the unit for production for the Model 240 airplane. The completed installation involves exhaust-gas turbines, nozzles, heat exchangers, twin ejectors, and triamese exhaust stacks. The system is expected to provide a net thrust of 200 lbs. per engine at 115 m.p.h. in a full-power climb, increasing the pay load by as much as 2,000 lbs. when compared with the conventional cowl-flap and collector installation.

Fuel Injection for Light Aircraft. George M. Lange. *Preprint, S.A.E. Annual Meeting,* Detroit, January 6–10, 1947. 40 pp., illus.

Following a brief review of past developments in gasoline injection, the Ex-Cell-O intake metering injection system for small engines is described. The basic system incorporates intake metering of fuel with a mechanical linkage between the fuel and air-throttle lever arms. Fuel flows from the fuel tank through the supply pump to the metering valve. The amount of fuel metered to the pumping plunger is dependent upon supply-pump pressure and throttle position. The pump throttle is calibrated and linked to the air throttle in the correct relationship to provide the proper amount of metered fuel for the corresponding metered air-flow over the operating range of the engine. The injection pump is suitable for both manifold and cylinder injection.

Complete Power Egg Ground Testing. R. W. Lahners. *Preprint, S.A.E. Annual Meeting,* Detroit, January 6–10, 1947. 20 pp., figs.

A detailed analysis of problems connected with the testing of power eggs of Constellation aircraft operated by Transcontinental & Western Air, Inc. Test-cell problems involved included the testing of engines after overhaul, tests to assure satisfactory performance of the power units, and tests to aid in checking-out and trouble-shooting. Four possible methods of testing power eggs are outlined and evaluated. Particulars are given about the method chosen because it seemed to offer a good compromise in practicability and economy and offered possibilities for development. The test procedure and testing equipment are described.

Fixed Ignition for Civil Merlins: Rolls-Royce Engine Developments. *Modern Transport,* Vol. 56, No. 1449, December 21, 1946, p. 7.

A New 1525 Horsepower Model of the Wright Cyclone 9. *Wright Aeronautical Corp., Release,* Recd. January 30, 1947. 2 pp., illus.

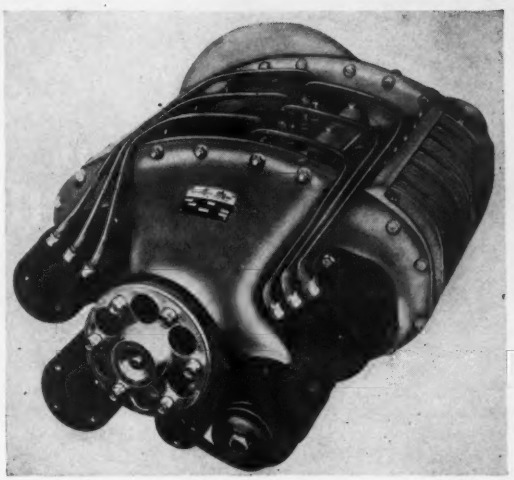
The new Wright Cyclone 9HE engine produces one hp. for each 0.93 lb. of weight, attaining its high power through use of a simple lightweight system of water injection or by operation on a gasoline of grade 122/145. Designed primarily for commercial transport operations, the engine is scheduled for use in the four-engined Curtiss-Wright CW32 cargo airplane. The cylinder head is of forged aluminum alloy and the barrels are cooled by "W"-type aluminum-alloy cooling fins.

Britain's Most Powerful Piston Engine, the Rolls-Royce "Eagle." *Rolls-Royce Ltd., Release,* January 30, 1947. 3 pp., illus.

The new Rolls-Royce 3,500-hp. Eagle is an H-type engine with four rows of six cylinders in line, with a two-speed, two-stage supercharger. A fuel injection pump discharges into the air stream at the supercharger. Sleeve valves were adopted as more convenient than overhead poppet valves for this particular lay-out. Dual ignition is provided by two B.T.H. waterproofed magnetos mounted on either side of the casing of the reduction gear for Rotol counterrotating, eight-blade propellers.

Army Orders New Franklin Engines to Power Consolidated-Vultee L-13 Liaison Planes. *Aircooled Motors, Inc., Release,* Recd. January 10, 1947. 1 p., illus.

These engines, Army designation 0-425-5, are now in production. Basically, the engine is similar to the commercial models, being of the six-cylinder, horizontally opposed type, air-cooled and nonsupercharged. It is equipped with propeller reduction gears, having a gear ratio of 0.623 to 1. Provision is made for a hydraulic governing system for a controllable propeller. Rated at 245 hp. at 3,300 r.p.m. for take-off, with a normal rating of 240 hp. at 3,200 r.p.m., the total weight of the engine is 405 lbs., about 1.65 lbs. per hp.



The two-cycle, opposed-piston supercharged engine built by McCulloch Motors Corporation for light airplanes. The 120-hp. model weighs only 150 lbs. (See "New Aviation and Marine Gasoline Engines.")

New Aviation and Marine Gasoline Engines. *McCulloch Motors Corp., Release,* Recd. January 10, 1947. 2 pp., illus.

Description of a new type of lightweight gasoline engine, for aircraft and marine use and ranging in power up to 120 hp., of two-cycle, opposed-piston, supercharged design. Weight of the 120-hp. model is 150 lbs. The main engine structure, including the integral cylinder block, is an aluminum-alloy high-pressure die casting, with thin cylinder liners shrunk in place. For ease of maintenance, all bolts have heads and nuts of the same size.

Target Aircraft Engine—Model 4300. *McCulloch Motors Corp., Release,* Recd. January 10, 1947. 2 pp., illus.

The Model 4300 two-cycle crankcase-scavenged target-aircraft engine develops more than 60 hp. at top speed and weighs 74 lbs. Target aircraft with these four-cylinder engines have been flown at speeds well above 200 m.p.h. No gears are used in the design, all accessories being driven from the free end of the crankshaft. Flat-top pistons are used in conjunction with "reverse-flow" scavenging. Most of the major parts of the engine are designed for die casting. At a propeller speed of 3,000 r.p.m., with 91-octane fuel and a compression ratio of 8 to 1, the rating is 53 b.hp. Additional specifications are included.

New Merlin for Atlantic Run Sleek, Versatile, Powerful. *Canadian Aviation,* Vol. 20, No. 1, January, 1947, pp. 50, 51, illus.

The construction of the Rolls-Royce Merlin 620 engine, which was designed to the specifications laid down by Trans-Canada Air Lines, is described. Tables give the important specifications and power ratings of this engine.

The Wasp Major. *United Aircraft Corp., Pratt & Whitney Aircraft Div.,* 1947. 38 pp., illus. (Cf. AER 1/46:124.) Descriptions and color plates of the internal parts of the Wasp Major engine.

1947 Annual Directory of Aircraft Engines. *Aero Digest,* Vol. 54, No. 1, January, 1947, pp. 107–110, 112, 114, 116, 118, illus. Specifications of 63 engines.

Engines, Rocket

Selection and Design of Rocket Power Plants. W. C. Roberts. *Paper presented at I.A.S. 15th Annual Meeting,* New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 37 of this issue, March, 1947.)

Thermodynamics of the Rocket Motor. Eric Burgess. *British Interplanetary Society, Journal,* Vol. 6, No. 3, December, 1946, pp. 82–90, figs.

The paper is mainly concerned with the thermodynamics of the liquid-fuel type, although many of the principles discussed also apply to the solid-fuel type. Following a general examination of the thermodynamic working cycle of the rocket engine,

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a more thorough investigation is made of the various parts of the cycle.

RMI'S Rocket Engine Which Powers Supersonic XS-1. John Shesta. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 44–46, illus.

Details about the liquid propellant regenerative rocket power plant developed by Reaction Motors, Inc., for propelling piloted aircraft at supersonic speeds. It develops upward of 6,000 lbs. total thrust, and consists of four combustion cylinders together with the necessary piping, wiring, and controls, supported by a single main beam assembly. Schematic diagrams show the construction of the combustion cylinder and the system of propellant supply.

The Evolution of Energy in Jet and Rocket Propulsion. V. P. Bielkowicz. *Aircraft Engineering*, Vol. 18, No. 214, December, 1946, pp. 419–423, figs. (Cf. AER 9/46:49.)

A discussion of the problem of attaining the highest velocity of ejection and the greatest thrust. As an example of how to deal with the problem, a mathematical study of hydrogen combustion is presented.

Principles of Rocket Flight. I, II. Arthur C. Clarke. *The Aeroplane*, Vol. 72, Nos. 1858, 1859, January 3, 10, 1947; pp. 14–16; pp. 48–50; figs.

Rocket Power. Louis Bruchiss. *Skyways*, Vol. 6, No. 2, February, 1947, pp. 33, 78, 82, illus.

Following an outline of the advantages of the rocket engine, details are presented about the 6,000-lb. thrust rocket engine built by Reaction Motors, Inc. The development of this unit is described and an analysis is made of its performance characteristics. Future developments and applications of rocket engines also are considered.

JATO Units Provide Added Thrust in Take-Off of Float-Equipped Cessna 140. *Edo Aircraft Corp., Release*, Recd. January 24, 1947. 1 p., illus.

Two small-sized Jato units were utilized in take-off from a dry-land runway, by the use of a standard airport dolly. The Jato units, rigged on the strut gear attachment, each provide 200 lbs. of thrust. In terms of added horsepower, this ranges from 72 hp. each, at rest, to 142 hp. each, at a speed of 50 m.p.h. The units were fired at an interval of 3 sec.

Rocket Test Stands. Willy Ley. *Air Trails*, Vol. 27, No. 5, February, 1947, pp. 54–56, 98–103, illus.

Although not yet standardized, these are of similar general design because of their same dual function of supplying the engine with fuel, and recording and measuring the fuel fed. The construction of rocket test stands is described. It is explained how the design of the test stand is dictated in part by the choice of rocket fuels. Problems connected with the measurement of rocket thrust are discussed.

Blockhouse for V-2 Rocket Tests. *Engineering*, Vol. 163, No. 4226, January 10, 1947, p. 31, illus.

Constructional features of the blockhouse containing the firing controls used in tests of V-2 rockets carried out by the U.S. Army at White Sands Proving Ground, N.M.

Power Plant Efficiencies; Further Correspondence on This Controversial Subject. *Aircraft Engineering*, Vol. 18, No. 214, December, 1946, pp. 417, 418, fig.

There Is No Obvious or Simple Way in Which to Use Atomic Energy for Space Ships. Luis W. Alverez. *U.S. Air Services*, Vol. 32, No. 1, January, 1947, pp. 9, 10, 26.

Jet-Assisted Take-Off. Arthur V. St. Germain. *Air Trails*, Vol. 27, No. 5, February, 1947, pp. 32–34, 76, 78, 79, illus.

The development of jet-assisted take-off and recent applications are reviewed. Details are supplied about the units designed and manufactured by the Aerojet Engineering Corporation. The different types of British and German rocket fuels, assisted take-off methods, and the future potentialities of assisted take-off are discussed.

Fire Prevention

Fire Factors in Aircraft Accidents. I. George H. Tryon, III. *Air-Sea Safety*, Vol. 1, No. 2-Vol. 2, No. 1, December, 1946-January, 1947, pp. 4–11, illus.

Records of the National Fire Protection Association show that fire occurs in a great majority of aircraft accidents. Analysis of 88 accidents reported between July 1 and November 1, 1946, reveals that fire took place in 67 per cent of the cases; fires following crashes are three times as prevalent as fires in flight; 60 per cent of all crashes, where fire does not originally occur in flight, are followed by fire. Although fires sustained in flight represented a minority of the cases studied and complete analysis of the causes was impossible, better fire-protection equipment in aircraft is indicated. Fire accidents accounted for 5.99 per cent of the total recorded in the Army Air Forces in 1945, a large part of these occurring in the power plant and in flight. Extensive statistics are given relative to the causes and extent of damages resulting from aircraft and airport fires.

Stop That Aviation Fire. *Air Transport*, Vol. 5, No. 1, January, 1947, pp. 19–34, illus.

Following a description of basic aircraft fire hazards, fire-extinguishing agents, and equipment, the discussion deals with airport fire protection, including the guarding of the hangars, and maintenance practices that help to prevent fires in the hangars and on the ramp. Provisions for rescue and extinguishing of crash fires also are discussed. Particulars are given about British fire-extinguishing practice, which differs somewhat from American methods. A check list for determining the extent to which an aircraft is protected against fire is included.

Preventing Fires. *The B-Liner*, Vol. 10, No. 1, January 15, 1947, pp. 3–5, illus. The equipment used by the fire department of Braniff Airways.

Flight Testing and Performance

Jet Airplane Range Considerations. Julius Jonas. *Journal of the Aeronautical Sciences*, Vol. 14, No. 2, February, 1947, pp. 124–128, figs. 3 references.

The lift coefficient for maximum range is both graphically and analytically determined. Engine overall efficiencies are discussed in their relation to range considerations. A maximum range expression is derived, first for the case of constant altitude and then for the case of constant engine and air speed. The two expressions are compared as to their relative values. Climbing range and maximum overall range are discussed. The range increase with altitude for a given amount of fuel is illustrated both by neglecting and by taking into account compressibility.

Assisted Take-Off in Relation to Transport Aeroplanes. L. L. Th. Huls. *Aircraft Engineering*, Vol. 18, No. 214, December, 1946, pp. 402–407, figs. 20 references.

Factors governing take-off performance are examined. Attention is given to the most important item of the take-off problem, namely, the take-off distance, which comprises three different stages. Although a detailed study of the calculation of the flight path in the three stages is not made because this is unnecessary, calculations are carried out which make possible the estimation of the principal parameters. Means of improving the take-off performance through changes in design and take-off assistance, the take-off problem for flying boats, and considerations with regard to landing are discussed.

Thoughts on Jet Training. R. P. Beamont. *The Aeroplane*, Vol. 72, No. 1860, January 17, 1947, p. 69.

Advances in the performance of fighter aircraft during the past 2 years have brought about not only increased landing speeds and higher minimum emergency speeds, but also the compressibility limitation, a condition that is new to the average pilot. The results of current development in fighter design on the piloting of aircraft and the required size for airfields are discussed.

Tests of the Effect of Wing-Tip Section on Stalling Properties of a Low-Wing Monoplane. I—Low-Taper Wings (Falcon). G. E. Pringle and R. H. Francis. **II—High-Taper Wing with N.A.C.A. 4415 Tip (Falcon).** R. H. Francis and A. W. G. Birch. **III—Note on the Improvement of the Stalling Characteristics of the Magister.** A. W. G. Birch. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2061*, June, 1941. 36 pp., figs. 12 references. British Information Services, New York. $1.08.

I. The tests were made on two Falcon airplanes having interchangeable extension wings of low taper. Results showed that wing-tip section and flap setting have a marked influence on the stalling of the low-taper Falcon. **II.** Comparative flight tests showed that the behavior at the stall is improved considerably by the change to NACA 4415 tip section and becomes better than that of most unslotted low-wing monoplanes even of low-taper ratio. **III.** In order to determine the effects of modifications to the leading edge of the wing, sharp wedges were fitted to the inboard portions of the wing leading edges, and later the leading edges of the outer wings, forward of the ailerons, were rounded. It was found that rounded fairings stabilized markedly

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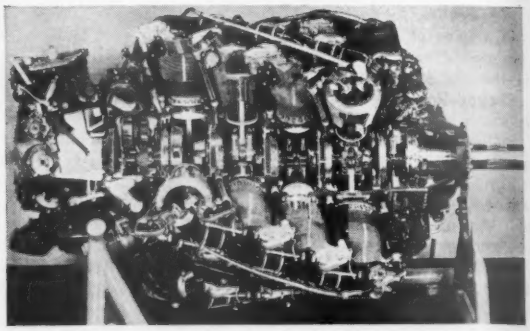

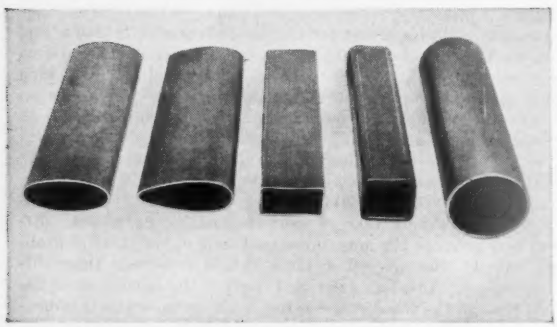

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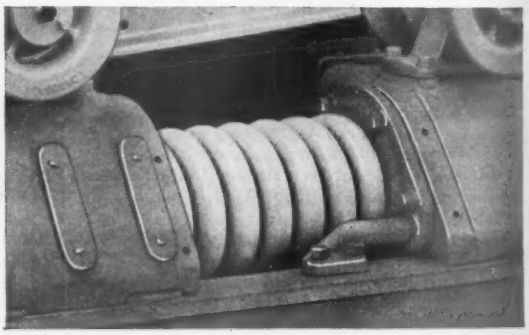

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the flow over the outer wing, and the behavior of the airplane with these modifications was fully satisfactory.

Measurements of Landing-Gear Forces and Horizontal-Tail Loads in Landing Tests of a Large Bomber-Type Airplane. John R. Westfall. *U.S., N.A.C.A., Technical Note No. 1140,* September, 1946. 68 pp., figs. 3 references.

A series of landings was made with a large bomber-type airplane equipped with twin vertical tails, to determine the time history of the impact forces on the landing gear and the resulting response of the airplane structure, particularly that of the horizontal tail, to the landing loads. About 50 landings were made, including normal, braked, and prerotation landings, but complete time histories were obtained for only 23 landings. The quantities measured included the vertical and drag components of the landing-gear loads, landing-gear deflection, stabilizer bending moments, structural accelerations, and airplane velocity and attitude. The tests were undertaken to investigate the specific causes of stabilizer failures on early models of the airplane, and it was found that the maximum stabilizer loads occurred in normal landings as a result of resonance with fore-and-aft landing-gear vibration. The data presented are adaptable to use in the analytic solution of the problem of structural response during landing impacts.

Notes on Stick Force Characteristics During the Initiation and Reversal of an Aileron Roll. M. B. Morgan and C. F. Bethwaite. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 1985,* August, 1943. 28 pp., figs. 5 references. British Information Services, New York. $1.50.

A theoretic study was undertaken of the stick forces involved in such operational maneuvers of a small fighter as rolling to an angle of bank of 90° and quickly reversing the roll to an equal extent in the opposite direction. An analysis applicable to the maneuver is set forth in detail, with explanations and mathematical expressions. Illustrative calculations give time histories of bank, rate of roll, and stick force during a roll from straight and level flight to a steady 90° bank and back again, for various rates of control application, illustrating the influence of rate of control application, aircraft inertia, incidence ratio, air speed, etc. General curves are provided for studying the stick force characteristics during the initiation of a roll, and geared-tab balance and spring-tab balance also are considered.

Tests to Determine Effects of Slipstream Rotation on the Lateral Stability Characteristics of a Single-Engine Low-Wing Airplane Model. Paul E. Purser and Margaret F. Spear. *U.S., N.A.C.A., Technical Note No. 1146,* September, 1946. 48 pp., figs. 14 references.

Tests were made of a $^1/_9$-scale powered model with three propeller-blade settings and three values of tail length. Estimates of lateral-force, rolling-moment, and yawing-moment coefficients due to slipstream rotation at zero pitch and yaw with flaps retracted were obtained from calculated slipstream characteristics and compared favorably with test values except in cases for which the vertical tail is near the effective edge of the displaced slipstream. Results indicated that the slope of the yawing-moment curve at zero yaw decreased generally with the use of higher propeller blade angles (or torque coefficient). The slope of the yawing-moment curve increased with tail length and varied relatively little with changes in blade angle. The slope of the curve of lateral force against angle of yaw increased with blade angle and tail length for the model without the tail. With tail on, change of blade angle had a negligible effect. It was necessary to use the full-scale thrust-torque relationship and rudder-trim settings in wind-tunnel tests to find the angle of yaw at which rudder lock will occur.

Specialized Instrumentation for Flight Testing. Joseph P. Paine. *Instruments,* Vol. 20, No. 1, January, 1947, pp. 30–34, illus. 3 references.

The method developed by The Glenn L. Martin Company of recording data during a flight test by means of the photographic observer utilizes a special instrument panel containing the test indicators which are photographed by a motion-picture camera whenever data are to be recorded. Aircraft pressure measurements, used to define pressure and flow characteristics on aircraft components, present considerable difficulty to the engineer. Not only must the proper pressure head be selected, but a satisfactory method of recording each pressure must be devised, particularly when a large number of pressures is to be measured. Details are given about the use of 85 altimeters on an A-30 airplane for the study of airfoil characteristics at supersonic speeds. The measurement of air speed, altitude, and dynamic loads is discussed.

Automatic Flight Recorder. *General Electric Co., Release,* January 28, 1947. 2 pp.

A new two-element flight recorder that continuously provides accurate, permanent records of an airplane's flight data will record two variable inputs such as altitude, vertical acceleration, air speed, compass heading, and any other operational data that can be measured with standard aircraft instruments, plus two "off-on" functions. Selsyns installed on the standard aircraft instruments transmit the position of the instrument's pointer to a receiver Selsyn in the flight recorder, which is geared to the inkless recording system.

Telemetering. L. Jerome Stanton. *Air Trails,* Vol. 27, No. 5, February, 1947, pp. 50, 51, 92–97, illus. The principles of telemetering and its various applications are described.

Recording Structural Loads. E. E. Trett. *Air Reserve Gazette,* Vol. 9, No. 1, January, 1947, p. 20, figs. Principles of the flight acceleration recorder.

Vacuum-Tube Acceleration Pickup. Walter Ramberg. *Journal of Research of the National Bureau of Standards,* Vol. 37, No. 6, December, 1946, pp. 391–398, illus.

This device, which measures accelerations in the range from ·5*g* to 40*g*, is being tested under various service conditions by several flight-research laboratories. The design embodies a fixed indirectly heated cathode and two plates on either side of the cathode, which are mounted elastically to deflect in response to acceleration normal to the plane of the plates. The tube has a natural frequency of about 800 cycles per sec., and it has a flat response for sinusoidal accelerations from 0 to 200 cycles per sec. with enough output at accelerations of the order of 10*g* to drive a recording galvanometer directly without the complications of an amplifier. Details are given about the use of this tube for recording vertical accelerations at the center of a model simulating an airplane subject to a drop test.

Fuels

The Synthesis and Purification of Aromatic Hydrocarbons. IV—1,2,3-Trimethylbenzene. J. M. Lamberti, T. W. Reynolds, and H. H. Chanan. **V—1-Ethyl-3-Methylbenzene.** Earl R. Ebersole. *U.S., N.A.C.A., Technical Notes Nos. 1163, 1164,* November, 1946. 14 pp., figs. 13 references. 9 pp., figs. 10 references.

IV. A 6-gal. quantity of 1,2,3-trimethylbenzene was prepared and purified in a four-step synthesis involving the condensation of 1,3-pentadiene with crotonaldehyde. The dimethylcyclohexenecarboxaldehydes formed were hydrogenated to give the corresponding isomeric dimethylcyclohexylcarbinols. The dehydration of the carbinols and the subsequent dehydrogenation of the trimethylcyclohexenes yielded the 1,2,3-trimethylbenzene. The overall yield was 24 per cent; the physical properties of the material are given. **V.** The method used for the synthesis and purification of an 8-gal. quantity of 1-ethyl-3-methylbenzene from m-cresol consists in obtaining m-methylcyclohexanone from m-cresol by hydrogenation followed by oxidation, condensation of the ketone with ethylmagnesium bromide, dehydration of the tertiary alcohol obtained, and dehydrogenation of the olefins to 1-ethyl-3-methylbenzene. A yield of 28 per cent of the theoretic was obtained from 98 per cent commercial m-cresol. The physical properties of 1-ethyl-3-methylbenzene are compared with selected values from the literature.

The Infrared Spectra of Spiropentane Methylenecyclobutane and 2-Methyl-1-Butene. Alden P. Cleaves and Mildred E. Sherrick. *U.S., N.A.C.A., Technical Note No. 1160,* October, 1946. 10 pp., figs. 10 references.

The infrared spectra of spiropentane, methylenecyclobutane, and 2-methyl-1-butene were measured in the region from 3 to 14 microns with a rock-salt prism spectrometer of medium dispersion. The vapors of these three C_5 hydrocarbons were investigated at room temperature and at pressures in the range from 80 to 300 mm. of mercury absolute in a 10-cm. cell. The spectra were compared with each other and with Raman data for the same compounds.

Purification, Purity, and Freezing Points of 7 Heptanes, 16 Octanes, 6 Pentenes, Cyclopentene, and 7 C_9H_{12} Alkylbenzenes of the API-Standard and API-NBS Series. Anton J. Streiff, Evelyn T. Murphy, Vincent A. Sedlak, Charles B. Willingham,

and Frederick D. Rossini. *Journal of Research of the National Bureau of Standards*, Vol. 37, No. 6, December, 1946, pp. 331–378, figs. 7 references.

Gliding and Soaring

Flight Tests of a Glider Model Towed by Twin Parallel Towlines. Marvin Pitkin and Marion O. McKinney, Jr. *U.S., N.A.C.A., Restricted Bulletin No. 3D30 (Wartime Report No. L-498)*, April, 1943. 14 pp., illus. 1 reference.

A Case for Glider Manufacturing in Australia. II, III. S. L. Kucharzewski. *Air-Log* (Sydney), Vol. 8, Nos. 8, 9, October, November, 1946; pp. 30, 32, diagr.; pp. 29–31, illus. (Cf. AER 1/47:49.) **II.** Description and three-view drawing of the Robin utility glider. **III.** Descriptions, specifications and performances of the Thompson-Millicer T-M.2 and the German Meise sailplanes.

A Survey of British Gliding. Ann C. Douglas. *The Aeroplane*, Vol. 72, No. 1859, January 10, 1947, pp. 40–42, illus.

Power Pilots Are Second Best. Johnnie Robinson. *Skyways*, Vol. 6, No. 2, February, 1947, pp. 28–30, 74, 80, illus.

A glider pilot and instructor discusses the technique of gliding and soaring and asserts that more real flying knowledge can be gained in this field than from the piloting of powered planes.

The Moazagotl and Minimoa; Some Details of the Sailplane Which Has Made British Gliding Records. F. Lindsley. *Air Reserve Gazette*, Vol. 9, No. 1, January, 1947, pp. 16, 17, illus.

Military Prototypes. XXVI—The Baynes Carrier Wing. *The Aeroplane Spotter*, Vol. 7, No. 178, December 26, 1946, p. 308, illus. Descriptive.

1947 Annual Glider Directory. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 81, 83, illus. Specifications of nine aircraft.

Guided Missiles

Remarks About Geometric Structure, and the Construction of the Boundary Curve of the Stability Range of Constants a_0, a_1, for a Characteristic Equation of the Sixth Degree. E. Scholz. (*Peenemünde, Heeresversuchsstelle, ZWB/PA/86/41*, August, 1940.) *U.S., Army Air Forces, Translation No. F-TS-1018-RE*, November, 1946. 4 pp., fig.

This is a basic problem in the calculation of the stability of a body controlled by an automatic pilot when a_0 and a_1 are the control constants relating control surface deflection to angle of yaw and rate of yaw, respectively. The curve is a parabola with a_0 and a_1 as coordinates.

News from Australia: Plans for the Establishment of the British Commonwealth Rocket and Remote-Control Aircraft Range in Central Australia. *The Aeroplane*, Vol. 72, No. 1858, January 3, 1947, p. 3.

Hydraulic Equipment

O-Ring Seals in the Design of Hydraulic Mechanisms. David R. Pearl. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 17 pp., figs.

Tests and service experience show that the O-ring seal offers a reasonable approach to the ideal requirements in many applications. The characteristics of the seal are outlined, with an explanation of the theory upon which it operates. Precompression of the seal between the piston and the cylinder and nonconfinement of the seal are essential, and the seal volume must be less than the groove volume under all tolerance conditions. O-ring seals are satisfactory in stationary or reciprocating applications for pressures up to 5,000 lbs. per sq.in., and to a limited extent on rotating shafts. Tables and formulas are set forth for the selection of materials and dimensions to suit various applications and for the estimation of friction. Charts show recommendations for seal clearances, diameters, compression, and pressures.

Hydraulic Systems in German Aircraft. II—The Do 335 Fighter-Bomber. M. Hodgson. *Aircraft Engineering*, Vol. 18, No. 214, December, 1946, pp. 413–416, figs. (Cf. AER 1/47:49.)

Details of the hydraulic system are set forth in sections dealing with the supply circuit; the main selectors; and the brake, landing gear, flap, cooling, and control-fulcrum circuits.

HC-3600 Unloader Valve. *Air Associates, Inc., Release*, Recd. January 3, 1947. 2 pp., illus.

The cut-in procedure of the HC-3600 unloader valve is opposite that of other types of unloaders in that the poppet travels "upstream" to shut off the by-pass flow. It may be used with or without an accumulator, and is capable of handling up to 20-gal.-per-min. flow without an excessive amount of pressure drop.

Operation of Aircraft Hydraulic Systems. IV—Operating Systems. Harvey A. Senior. *Aviation Service Magazine*, January, 1947, pp. 20–25, 62, figs. Operation and maintenance of the typical retractable landing-gear hydraulic system and its units, including the sequence and automatic temperature-control valves.

Ice Prevention

A Thermal De-Icing Installation. *The Aeroplane*, Vol. 72, No. 1861, January 24, 1947, pp. 100, 101, illus.

De-icing equipment recently developed by Miles Aircraft, Ltd., is being installed in a second prototype Marathon aircraft. Heat is applied directly to the wings and tail unit. Supports for the baffles and other parts of the system are built into the wing and contribute to the general strength of the wing structure. The deicing equipment is tapped to provide adequate cabin heating.

De-Icing To-day: Points of the Thermal System: Induction System Problems. J. K. Hardy. *Flight*, Vol. 50, No. 1982, December 19, 1946, pp. 673, 674, illus. (Extended abstract of a paper.)

Temperature and the Probability of Aircraft Icing in the Alaskan-Aleutian Area. Benjamin F. Taylor, Jr., and O. N. Serbein, Jr. *American Meteorological Society, Bulletin*, Vol. 27, No. 10, December, 1946, pp. 580–588, tables.

Laboratory Investigation of Icing in the Carburetor and Supercharger Inlet Elbow of an Aircraft Engine. *U.S., N.A.C.A.*

I—Description of Setup and Testing Technique. Donald R. Mulholland, Vern G. Rollin, and Herman B. Galvin. *Memorandum Report No. E5L13 (Wartime Report No. E-170)*, December, 1945. 22 pp., illus. 5 references.

II—Determination of the Limiting-Icing Conditions. Henry A. Essex, Wayne C. Keith, and Donald R. Mulholland. *Memorandum Report No. E5L18a (Wartime Report No. E-171)*, December, 1945. 35 pp., illus. 3 references.

III—Heated Air as a Means of De-Icing the Carburetor and Supercharger Inlet Elbow. Richard E. Lyons and Willard D. Coles. *Memorandum Report No. E5L19 (Wartime Report No. E-172)*, December, 1945. 25 pp., figs. 3 references.

IV—Effect of Throttle Design and Method of Throttle Operation on Induction-System Icing Characteristics. G. E. Chapman and E. D. Zlotowski. *Memorandum Report No. E5L27 (Wartime Report No. E-173)*, January, 1946. 14 pp., illus. 3 references.

V—Effect of Injection of Water-Fuel Mixtures and Water-Ethanol-Fuel Mixtures on the Icing Characteristics. Clark E. Renner. *Memorandum Report No. E5L28 (Wartime Report No. E-174)*, December, 1945. 10 pp., figs. 2 references.

VI—Effect of Modifications to Fuel-Spray Nozzle on Icing Characteristics. Donald R. Mulholland and Gilbert E. Chapman. *Memorandum Report No. E6A23 (Wartime Report No. E-175)*, January, 1946. 21 pp., illus. 6 references.

Instruments—General

Servicing Tips for Airliners. VII—Instruments. Allen Merkin. *Aviation Maintenance & Operations*, Vol. 7, No. 2, January, 1947, pp. 30, 31. (Cf. AER 2/47:54.) For the Lockheed Constellation and the Douglas DC-3 and DC-4.

Instruments, Engine

New Pyrometer for Gas Turbines and Jet Engines. *U.S., National Bureau of Standards, Release No. ES-1046*, Recd. February 3, 1947. 2 pp.

An improved pyrometer for measuring the temperatures of high-temperature, high-velocity gas streams developed in cooperation with the Bureau of Ships, Navy Department, consists essentially of an ordinary thermocouple junction around which is pressed a small, light, silver shield. Silver, being a good reflector and a poor emitter of radiant heat energy, keeps the temperature of the shielded junction nearly the same as that of the gas. The new device was found accurate to within 5°F. in experiments utilizing a stream of gas at 1,500° flowing with a velocity at 250 ft. per sec. through a pipe with walls at 1,200°.

An Instrument for Piston Temperature Measurement. A. C. Scholp, G. R. Furman, and P. A. Binda. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 16 pp., figs. 26 references.

Contactor methods used in the determination of internal-combustion piston temperatures through the use of a thermocouple are discussed. Particulars are given about designs of single and multipoint piston thermocouple contactors suitable for high-speed work which have proved satisfactory over long operating periods, and about the proof tests of these devices. The designs contain simple provisions for the replacement of usual wearing parts for simplicity and continuous operation.

An Ignition Analyzer for Internal Combustion Engines. H. C. Welch and J. V. McNulty. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 13 pp., figs.

The construction and operation of the Bendix-Scintilla Ignition Analyzer, a portable instrument that can be quickly attached to any high-tension or low-tension ignition system regardless of the number of cylinders or number of engines. A complete air-borne installation for a four-engined plane weighs 37 lbs. Images appearing on a cathode-ray tube record the operation of each cylinder and indicate the location and cause of faulty operation. The circuits controlling the cathode-ray tube are similar to those of a standard oscilloscope but without certain stages, and incorporating a unique circuit not found in an oscilloscope. That circuit is a constant-amplitude sweep which maintains a constant-width pattern on the screen regardless of the engine speed. Vertical oscillations of the beam appearing on the screen, caused by rapid changes in voltage, indicate the firing action of the spark plug.

Engine Trouble Shooting in the Air. John E. Lindberg, Jr., and Clifford Sackett. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 21 pp., illus.

Description of an engine analyzer that provides continuous visual analysis of the complete aircraft power plant during flight. With this instrument the flight engineer can at any time examine the characteristic oscillograph patterns of ignition-system performance, changes in mixture distribution, synchronization between magnetos and between engines, engine roughness, engine vibration, and the performance of hydraulic and electrical accessories. These patterns detect, locate, and identify malfunctions and imminent failures that may occur during operation, and also permit the flight engineer to adjust the engine for optimum performance. Engine patterns can be examined singly for an individual cylinder or simultaneously for all cylinders.

Instruments, Flight

New 'Electron Gun' Compass Announced as Most Accurate. *Minneapolis-Honeywell Regulator Co., Release*, January 28, 1947. 2 pp.

The Cathotrol, a compass containing no moving parts, provides direction signals and guides an airplane or ship on a preset course. It is coupled to the directional gyroscope of a Honeywell electronic autopilot and can be equipped with any number of direction indicators to give a visual picture of flight direction. The compass consists primarily of a specially designed vacuum tube that houses an "electron gun" firing a constant and focused stream of electrons at four small target plates. This beam is equally divided between the target plates when the gun is pointed in the direction of the earth's magnetic field, but in any other position the earth's pull bends some of the beams so that they strike the target unevenly. Signals picked up from the four target plates are fed directly to a vector resolver or computer, which measures the infinitesimal differences of impact of the beam upon the plates and uses these signals to position a small, high-speed gyro. The gyro transmits its own signals to the autopilot and to the various indicators.

Lightweight Automatics. *Flight*, Vol. 50, No. 1982, December 19, 1946, pp. 665, 666, illus.

The Miles Co-Pilot has been described as being of the "two-axis" type. This is true as far as the controlling part of the system is concerned but the automatic pilot itself provides corrections for movement in all three axes. The pitch corrections are made to the elevator control, and the yaw and roll corrections are made through the ailerons. Such a system would obviously not provide directional-control accuracy of an order demanded for special military purposes but it is believed to be adequate for all normal corrections in modern aircraft.

Beating the Stall. John H. Lancaster. *Flying*, Vol. 40, No. 2, February, 1947, pp. 38, 39, 76, illus.

A new warning indicator is designed to sound a horn and flash a light when a stall approaches. It consists of a small vane, which can be attached to the leading edge of either wing, and a horn-light unit for location on the flight panel.

Basic Instruments and Their Function. II—Air Speed Indicator. Bernard I. Diamond. *Southern Flight*, Vol. 27, No. 1, January, 1947, pp. 20–22, figs. (Cf. AER 2/47:53.)

Instruments, Meteorological

Some Instrumental Deficiencies of Cup Anemometers. Ronald L. Ives. *The Journal of Meteorology*, Vol. 3, No. 4, December, 1946, pp. 122, 123, figs. 3 references.

Wind-speed measurements and wind-profile studies disclosed a large number of apparent discrepancies in single or short-term measurements. Some deficiencies noted during 45 months of intensive field and laboratory wind research, and remedial measures that have been tested in actual field operations for periods exceeding 6 months are described.

Automatic Weather Stations. Louvan E. Wood. *The Journal of Meteorology*, Vol. 3, No. 4, December, 1946, pp. 115–121, illus. 5 references.

The history of automatic weather stations is outlined. The Navy-type station described broadcasts measurements of atmospheric pressure, temperature, relative humidity, wind direction, wind speed, and rainfall according to a predetermined schedule.

A Gradient Wind-Speed Computer. Philip D. Thompson. *American Meteorological Society, Bulletin*, Vol. 27, No. 10, December, 1946, pp. 564–568, figs.

Insurance, Safety, and Rescue

Air Safety Gains Reflected in 1946 Life Policy Rules. *Institute of Life Insurance, Monthly Press Release*, January 29, 1947. 1 p.

Statistics show the increasing recognition by life-insurance companies of the gains made in flight safety by the scheduled air lines. Of a group of life-insurance companies surveyed, representing more than 80 per cent of the total life-insurance business, 98 per cent now issue policies at standard rates to passengers on scheduled commercial air lines, compared with 87 per cent a year ago and with only 4 per cent in 1935. More liberal coverage also is being extended to the crews of scheduled air-line airplanes. A chart illustrates the statistics.

Non Air Carrier Accidents in 1945—A Statistical Analysis Thereof. *U.S., Civil Aeronautics Board*, January 23, 1947. 27 pp., tables.

A statistical analysis of the 4,652 nonair-carrier accidents shows that: the overall accident rate was lower by 11.4 per cent; reckless, low, and "show-off" flying, together with student pilots carrying passengers, accounted for 41 per cent of the 614 fatal and serious accidents; the ratio of fatal and serious accidents in 1945 was 13.2 per cent as compared with 10.2 per cent in 1944; washout damage was 17 per cent against 14.5 per cent in 1944 and 12.8 per cent in 1943; in 76.9 of each 100 accidents, no personal injury occurred; a total of 7,252 persons were involved in the 4,652 accidents. Of these, 508 were fatally and 446 seriously injured.

Comparative Safety Statistics in Scheduled Air Carrier Operations (Domestic and International), Calendar Years 1945 and 1946. *American Aviation*, Vol. 10, No. 17, February 1, 1947, p. 16.

Misleading Statistics: Candid Comments on "Passenger-Mile" Safety Criterion. *Flight*, Vol. 51, No. 1985, January 9, 1947, pp. 42, 43, illus.

How Do They Know What Happened? *Popular Science Monthly*, Vol. 150, No. 1, January, 1947, pp. 85–89, illus. The methods used by the Accident Investigation Division of the Civil Aeronautics Board in determining the causes of aircraft accidents.

The Bail-Out Problem. R. C. Hovde. *Air-Sea Safety*, Vol. 1, No. 2-Vol. 2, No. 1, December, 1946-January, 1947, pp. 18–22, illus.

Circumstances governing bail out by fighter pilots are analyzed, and certain inadequacies of parachute equipment are cited, although the underlying cause in most cases is pilot failure. Better cockpit construction would encourage forced-landing procedure instead of bail out, with the probability of greater pilot safety.

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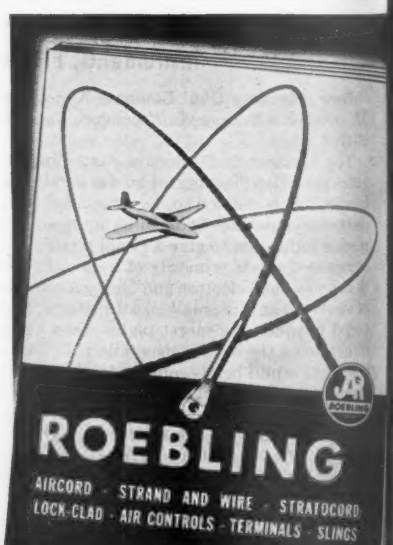

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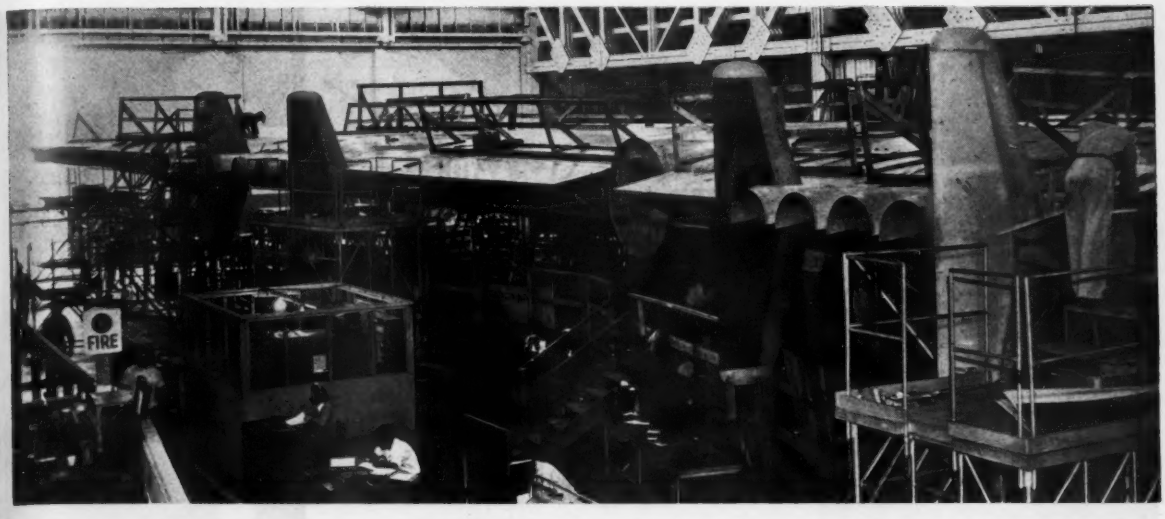


The Northrop Flying Wing YB-49 has eight jets in two "clusters" of four each. Vertical fins act as "air separators," adding to the directional stability. Each jet develops 4,000 lbs. of thrust.

Research in bail-out procedure by the Navy Flight Safety Section stresses training for the men and simplified training equipment.

Don't Drink and Fly. Harold G. Crowley. *U.S., Civil Aeronautics Board, Safety Bulletin No. 175–47*, January 15, 1947. 3 pp. U.S., Govt. Printing Office, Washington. $0.05.

Survey of Air Rescue Requirements. Jerome Lederer. (Paper presented at I.A.S. Fourth Annual National Air Transport Meeting, Washington, October 4, 1946.) *Air-Sea Safety*, Vol. 1, No. 2-Vol. 2, No. 1, December, 1946-January, 1947, pp. 51–61, illus. (Cf. AER 12/46:23.)

Forest Service Facilities Aid Aviation. Lyle F. Watts. *Air-Sea Safety*, Vol. 1, No. 2-Vol. 2, No. 1, December, 1946-January, 1947, pp. 27–36, illus.

Allocation of Out-Of-Pocket Expenses in Rescue at Sea. Alan Osborne. *Air-Sea Safety*, Vol. 1, No. 2-Vol. 2, No. 1, December, 1946-January, 1947, pp. 16, 17, illus.

Quotations from regulations concerning compensation payable to the owners or crew of surface ships for expenses in connection with the rescue of aircraft in distress at sea, with comments and suggestions about rescue work.

Landing Gear

Aircraft Auxiliary Systems. I, II. *The Aeroplane*, Vol. 72, Nos. 1859, 1860, January 10, 17, 1947; pp. 37, 38; pp. 76, 77, Discussion, pp. 77, 78; figs. (Extended abstracts of three papers: "The Aeroplane Undercarriage." H. G. Conway; "Ultra-High Pressure Hydraulic Systems." S. M. Parker; "Aircraft Wheel Brakes." D. A. L. Robson.)

The first paper deals with mechanical engineering aspects of landing-gear design, and describes methods of determining the capacity and stroke of the shock absorber, methods of calculating telescopic friction, and details of landing-gear stressing. The second paper discusses the use and design requirements and problems of ultra-high-pressure hydraulic systems. The third paper contains a detailed exposition of the problems of airplane wheel-brake design and describes some typical brake systems in current use.

Landing Gear Pre-Rotator Housed Within Wheel. *Aviation*, Vol. 46, No. 1, January, 1947, p. 55, illus.

An electric landing-gear wheel prerotation unit developed by Otto E. Dever of Burbank, Calif., is scheduled for tests on a Lockheed Constellation. The unit is provided with a ring-type winding that can be varied to achieve the prerotation speeds necessary for different aircraft.

Rotative Flight Brake Proposed to Moderate Landing Speeds. James G. Ray. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 52, 53, figs.

It is suggested that an autorotating rotor, pulled through the air with the disc at right angles to the direction of motion be installed at the tail of small aircraft for use as a flight brake.

Brake Equalizing and Bleeding Test Panel, Greer Model BEB-1. *Greer Hydraulics, Inc., Release*, Recd. January 27, 1947. 1 p., illus.

The unit was specifically designed for quick, accurate servicing of the brakes used on the Douglas DC-4 and DC-6. It is portable, self-contained, and incorporates all necessary components such as gages, valves, manifolds, and hose lines for rapid operation.

The General Airplane Tires and Equipment. *The General Tire & Rubber Co., Catalog*, January 13, 1947. 29 pp., illus. Information about the construction features of General airplane tires is supplemented by tabulated specifications for main-wheel and tail-wheel tires and accessories.

Lubrication and Lubricants

Foaming of Aircraft-Engine Oils as a Problem in Colloid Chemistry. I. J. W. McBain, S. Ross, and others. *U.S., N.A.C.A., Advance Restricted Report No. 4I05 (Wartime Report No. W-52)*, September, 1944. 128 pp., figs. 36 references.

Foaming of Lubricating Oils. C. E. Trautman. *Lubrication Engineering*, Vol. 2, No. 4, December, 1946, pp. 143–146, illus. The outstanding results obtained with the use of silicones as anti-foaming agents in lubricating oils are described.

Silicone Lubricants. I. T. A. Kauppi and W. W. Pedersen. *Lubrication Engineering*, Vol. 2, No. 4, December, 1946, pp. 158–161, illus. A discussion of silicone polymers, the properties of silicone fluids, and tests used to evaluate the lubricating properties of experimental silicone fluids.

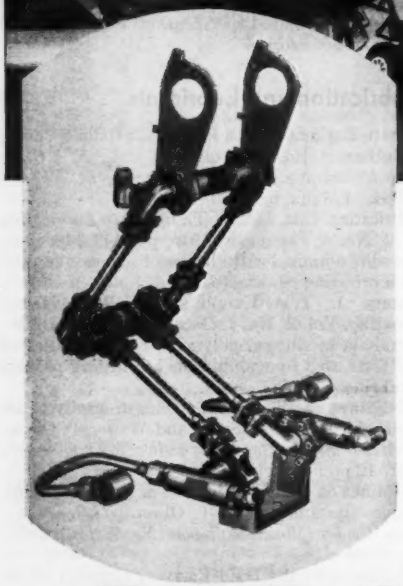
The Effect of Xylidines on the Load-Carrying Capacity of an Aircraft-Engine Oil. I. Robert A. Spurr and Walter T. Olson. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-157)*, August, 1943. 12 pp., figs. 5 references.

The Effect of Xylidines on the Corrosiveness of Aircraft-Engine Oil. Emanuel Meyrowitz and Walter T. Olson. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-156)*, July, 1943. 9 pp., illus. 3 references.

The Effect of Xylidines on the Load-Carrying Capacity of an Aircraft-Engine Oil. II. Walter T. Olson and Robert A. Spurr. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-160)*, September, 1943. 10 pp., figs. 1 reference.

The Effect of Xylidines on the Stability of an Aircraft-Engine Lubricating Oil. Walter T. Olson and Emanuel Meyrowitz. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. E-158)*, August, 1943. 11 pp., figs. 5 references.

Bibliography of Papers and Books on Lubrication and Related Subjects Published in Germany During the Period 1940 to 1944. II. H. Blok. *Lubrication Engineering*, Vol. 2, No. 4, December, 1946, pp. 169–171. About 100 references.



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Maintenance

Maintenance of Electric Automatic Cooling Flap Control. I—Principles of Operation and Installation. Russell A. Gund. *Aviation Maintenance & Operations*, Vol. 7, No. 2, January, 1947, pp. 26, 27, 87, 88, illus.

Hawker Experience in Structural Repairs. II. E. C. Whittingham and Gisbert D. S. Garrett. *Aircraft Engineering*, Vol. 18, No. 214, December, 1946, pp. 427–433, illus. (Cf. AER 2/47:54.)

Additional methods of repairing war-damaged airplanes are described. One conclusion reached is that while stressed-skin construction has reduced the diversity of repairs and simplified their design, the overall size of each repair, and especially the size of repair by replacement, is steadily increasing.

1,500 B-29's to Be Saved by New Storage Process. *U.S., War Dept., Release*, January 12, 1947. 2 pp.

Recent experiments have revealed that it is possible to preserve large aircraft from corrosion during out-of-door storage by spraying them with an airtight plastic covering.

Maintenance Job Methods. II. James M. Linde. *Air Transport*, Vol. 5, No. 1, January, 1947, pp. 71–73. (Cf. AER 1/47:54.) Maintenance instructions for the power plants of the Douglas DC-4 and Lockheed Constellation.

Aircraft Servicing. *Kelite Products, Inc.*, 1946. 19 pp., illus. A catalog of cleansing agents for the external surfaces, interiors, and engines of airplanes. Special products are prepared for each of the various cleaning operations.

Tips on Cleaning Materials and Methods. W. B. Spooner, Jr. *Aviation Maintenance & Operations*, Vol. 7, No. 2, January, 1947, pp. 28, 29, 74, 76, 77, illus. Cleaning of the air frame and engine, and airport hangars, runways, and markers.

Proved Maintenance Methods Service TCA's North Star. A. M. Sutherland. *Canadian Aviation*, Vol. 20, No. 1, January, 1947, pp. 64, 66, illus.

Trans-Canada Air Lines has decided on a system embodying progressive preventive maintenance with unit or exchange overhaul for servicing North Star transport aircraft. Features of the system are presented.

Planning Airline Maintenance. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 204, 208, illus. Maintenance procedures being worked out by United Air Lines in preparation for the new Douglas DC-4 and DC-6 airplanes in course of delivery.

Materials—General

Aspects of the Determination of the Strength of Materials. E. W. J. Mardles. *The Royal Aeronautical Society, Journal*, Vol. 51, No. 433, January, 1947, pp. 65–68. Abstracts of five papers: "The Investigation of Failures in Wood by Microscopical Examination." M. C. Pryor and A. Rayne; "The Effect of Duration of Loading on the Strength of Brittle Materials." C. Gurney; "Application of Statistical Methods to Mechanical Test Results." B. Chalmers and E. R. W. Jones; "Griffith Theory of Cracks in Solids and Recent Developments of This Theory, with Application to Brittle Fracture in Glass and in Metals." N. F. Mott; "Application of Statistical Methods to Mechanical Test Results." B. Chalmers and E. R. W. Jones.

Materials—Metals and Alloys

Powder Metallurgy; Influence of Some Processing Variables on the Properties of Sintered Bronze. H. L. Wain. *Australia, Council for Aeronautics, Report No. ACA-25*, June, 1946. 20 pp., illus. 13 references.

The variables considered were compacting pressure, temperature of heat-treatment, and time of heat-treatment. It was found that an increase in compacting pressure at room temperature caused a general consolidation of the powder mass, the effect for a given increase being more pronounced at lower pressures. Evidence was obtained that compacting pressure can influence the disposition of the component powder particles, this being particularly evident with higher compacting pressures. At heat-treatment temperatures up to 700°C. there was definite progress in crystal recovery, recrystallization, and grain growth, but the rate of grain growth and sintering increased markedly above that temperature. The marked increase in sintering which occurred between 700° and 800°C. resulted in a pronounced shrinkage of the low-pressure samples in this range. The time of heat-treatment in excess of 30 min. was found to be of relatively minor importance as compared with compacting pressure and heat-treatment temperature.

Residual Stresses in Aluminum Alloys. I. R. M. Brick. *Aluminum and Magnesium*, Vol. 3, No. 3, December, 1946, pp. 8–11, 26, 27, figs. 7 references.

A discussion of the measurement of stress intensity by mechanical methods, such as boring, cutting, and slitting. Typical data on quenched aluminum-alloy cylinders are presented. Details are supplied about the use of wire strain gages and strain rosettes for determining the direction and intensity of the principal stresses, and the X-ray analysis of machining and other stresses in aluminum-alloy shapes.

New Strong Aluminum Casting Alloy. Harold Knight. *Materials & Methods*, Vol. 25, No. 1, January, 1947, pp. 68–71, illus.

A new alloy containing 11.20 per cent magnesium has a minimum tensile strength of about 60,000 lbs. per sq.in., which is comparable to that of malleable iron and some steels. It is a product of Acme Aluminum Alloys, Inc.

Influence of Shot Peening on Fatigue Strength of 14ST (Aluminum) Alloy. C. B. Gleason. *The Iron Age*, Vol. 159, No. 2, January 9, 1947, pp. 62–64, figs.

In an investigation carried out by the General Electric Company, tests of unnotched specimens indicated the possibility of increases in life of as much as 80 times that of unpeened material. Notched specimens showed more than 32 per cent improvement in fatigue strength. The data presented are considered to be of indicative value only, and a basis for further work, since there was a considerable amount of scatter.

Wrought Aluminum Alloy Nomenclature. O. L. Mitchell. *Aluminum and Magnesium*, Vol. 3, No. 3, December, 1946, pp. 13, 15, 30, 32, tables.

Some Advantages and Assets of Magnesium. R. J. Cross. *Aluminum and Magnesium*, Vol. 3, No. 3, December, 1946, pp. 17–19, 33, illus. (Extended abstract of a paper.)

The Fatigue Strengths of Some Wrought Aluminum Alloys. G. W. Stickley. *U.S., N.A.C.A., Restricted Bulletin (Wartime Report No. W-83)*, June, 1942. 7 pp. 2 references.

Canadian Research on Magnesium Alloys. J. W. Meier. *Modern Metals*, Vol. 2, No. 12, January, 1947, pp. 20–24, illus. The organization, research facilities, and an account of the work of the Bureau of Mines of the Department of Mines and Resources, Ottawa.

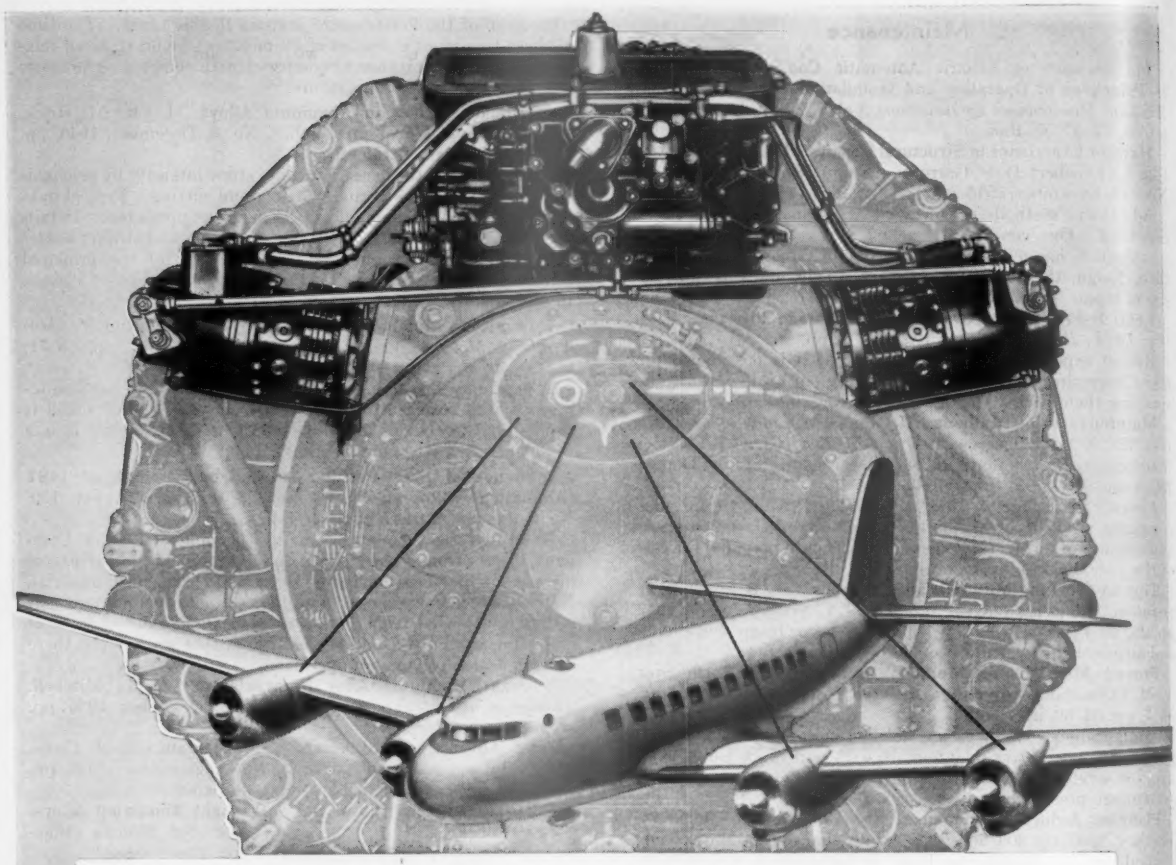
Aeronautical Research in Japan: Metallurgy. J. B. Dance. *Australia, Council for Scientific and Industrial Research, Division of Aeronautics, Report No. SM. 77*, August, 1946. 159 pp., tables. 151 references.

The emphasis has been placed on research work and research establishments, but details are given about the metals and alloys used in Japanese aircraft and engines at the end of the war. The Japanese understood fully the need for research and during the last three decades had built up a large, well-equipped research organization in the fields of aeronautics and metallurgy. Much work of a high standard had been done and the research personnel on the whole appeared to be competent. During the war the Japanese did not use their research facilities to the fullest extent and allowed much fundamental work of doubtful value to the war effort to continue. There were no extraordinary developments in the metals and alloys used in aircraft construction except for the use of a high-strength zinc containing aluminum alloy for aircraft spars. Their work on high-temperature alloys had lagged considerably behind that of the Allies.

Materials—Plastics and Plywood

Sandwich Materials: Metal Faces Stabilized by Honeycomb Cores. W. W. Troxell and H. C. Engel. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 18 pp., figs.

A summary of information concerning constructions having 24S-T Alclad aluminum-alloy faces and a plastic honeycomb core, the structure being bonded by Plycozite adhesive. Tests were made for flexural, compressive, shear, fatigue, creep, and crushing or surface-damage characteristics, and for the effects of weathering and water immersion. Details of the test methods, specimens, and conditions are reported, and tables and graphs give figures indicating the results.



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Experiences of an Aircraft Manufacturer with Sandwich Material. H. B. Gibbons. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 30 pp., illus.

Metalite sandwich-type panels were used for more than 75 per cent of the airfoil surface and for nearly all of the internal shear webs of the Chance Vought XF5U-1 Navy fighter, for approximately 95 per cent of the structure of the XF6U-1 jet-propelled Navy fighter, and will be used for the stabilizers of the F4U Corsair. One of the important advantages of the material is the smoothness and fairness obtained for aerodynamic surfaces. Problems involved in the development and use of the material, which consists of aluminum-alloy faces bonded to a balsa wood core, are reviewed, especially the design factors incidental to determining the stress distribution in the structure and methods of joining the sheets. Other questions discussed are those arising in the manufacture of the material and repairing structures made of it. Extensive tests have demonstrated the satisfactory results achieved. Domestically produced core material, such as impregnated Fiberglas or other synthetics, may replace foreign-grown balsa wood. Inorganic adhesives and cements also may be required to provide improved bonding agents.

Philosophy for Design of Sandwich Type Structure. John F. Korsberg. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 8 pp., fig.

Specifications for sandwich-type materials are viewed from the standpoint of the airplane manufacturer who uses the material. The qualities outlined are exemplified by the interior panel and floor structure of the Boeing Model 377 Stratocruiser. The different types of sandwich materials are compared with respect to the applications and methods of installation. The material is considered also for aerodynamic surfaces and other structural parts of the airplane. The use of sandwich structure could be further extended by the development of a core material of the relatively light weight of 10 to 15 lbs. per cu.ft., with shear strength in the vicinity of 3,000 lbs. per sq.in., and with sufficiently small voids to permit normal riveting methods without supplementary fitting.

Some Causes of Variability in the Results of Plywood Shear Tests. D. W. Bensend and R. J. Preston. *U.S., Forest Products Laboratory, Madison, Wis., Report No. R1615*, June, 1946. 24 pp., figs.

Standard shear-test specimens of three-ply $^3/_{16}$-in. yellow birch were used. The plywood was made with melamine glue and, in a few instances, with phenol thermoplastic or urea-resin glues. The independent variables studied included: alignment of jaws; distance between jaws; side play in the grips; jaw pressure; rate of loading; position of saw cuts with respect to direction of slope in the face plies; type, depth, and width of saw cut; moisture content at time of gluing and testing; and time of exposure of specimens to relatively dry air. Each experiment was so designed that the data could be analyzed statistically.

Modified and Improved Wood in Western Germany. R. M. Seborg and H. O. Fleischer. *U.S., Field Information Agency Technical, Final Report No. 394*, October 17, 1945. 47 pp. U.S., Forest Products Laboratory, Madison, Wis.

Modified wood products, and products of wood improved by chemical or mechanical treatment, manufactured in Germany were, in the opinion of the investigators, not superior to those made in the United States, and the techniques used in Germany for manufacturing improved wood are well known in the United States. The most significant information gained from the investigation, was the wide extent to which improved wood was manufactured and used in industry. Densified wood, generally known in Germany as "Pressholz," has been made from both laminated and solid wood. Beech, because of its availability and strength properties, is the chief species used for this material.

Low-Pressure Phenolics Prove Versatile in Aircraft Sandwich Construction. H. R. Jenks. *Pacific Plastics*, Vol. 5, No. 1, January, 1947, pp. 13–15, illus.

An outline of the characteristics and applications of "Conolon," which was developed at the Consolidated Vultee Aircraft Corporation and is manufactured by Narmco, Inc. It is being used in the manufacture of hot-air and ventilating ducts, seals, flooring, control surfaces, and other structural aircraft parts.

Foamed Cellulose Acetate—A New Plastic. R. A. Hoffer. *Materials & Methods*, Vol. 25, No. 1, January, 1947, pp. 58–61, illus.

Recent tests at Wright Field of a wing structure having faces of Fiberglas impregnated with a heat-setting resin and a supporting core of foamed cellulose acetate have given additional evidence of the great strength/weight efficiency and the excellent performance made possible by sandwich construction. Cellular cellulose acetate, or CCA, is a thermoplastic material produced by extrusion. The mechanical, thermal, and other properties of this product are described. Its applications to aircraft are enumerated.

The Use of Laminac Resin as a Sealant for Porous Metal Castings. *American Cyanamid Co., Release*, Recd. January 7, 1947. 4 pp., diagrs.

Medicine

The Limiting Effect of Centripetal Acceleration on Man's Ability to Move. Charles F. Code, Earl H. Wood, and Edward H. Lambert. *Journal of the Aeronautical Sciences*, Vol. 14, No. 2, February, 1947, pp. 117–123, illus. 2 references.

Instances have been recorded in which fliers were unable to bail out of spinning aircraft because of the centrifugal force generated by the spin. A study designed to give an estimate of the restrictions placed on man's locomotive ability by exposure to radial *g* (centrifugal force) was made on the human centrifuge. Five subjects were studied. The average time required to don a parachute was increased from 17 sec. at 1*g* to 1 min. and 15 sec. at 3*g*, it being uniformly agreed by the subjects tested that they could not don the parachutes at accelerations slightly above 3*g*. The ability of the subjects to move against the force or at right angles to the force was seriously restricted when the magnitude of the force was 2 to 3*g*. Progress against the force became impossible at 3*g*. Moving the body at right angles to the force became impossible in the neighborhood of 4*g*. The study demonstrated that under conditions at which accelerations of 3*g* or more develop, fliers will need help if they are to escape from their aircraft. Emphasis is therefore given to the need, recognized for some time by others, of further consideration and development of devices designed to assist the flier when escaping from his aircraft.

Toxic Respiratory Gases in Aviation. Orr E. Reynolds. *Air-Sea Safety*, Vol. 1, No. 2-Vol. 2, No. 1, December, 1946-January, 1947, pp. 23–26, fig.

Under certain circumstances gases such as oxygen, nitrogen, carbon dioxide, methyl bromide, hydrocarbon fuels, and others, ordinarily innocuous, can result in poisoning the occupants of aircraft. Symptoms of carbon monoxide poisoning, percentages of saturation, and other aspects are discussed. A nomograph is presented for estimation of carbon monoxide uptake by personnel breathing air or from oxygen equipment.

Ear Disorders in Flying. Norman C. Johnson. *Contact* (Pensacola, Fla.), Vol. 6, No. 2, January 1, 1947, pp. 177–188.

Meteorology

A New Operational Basis for Weather Forecasting. B. G. Holzman. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 38 of this issue, March, 1947.)

Maximum Density-Altitude in the Continental United States. George E. Forsythe and Morris S. Hendrickson. *American Meteorological Society, Bulletin*, Vol. 27, No. 10, December, 1946, pp. 576–579, figs.

To aid nonmeteorologists concerned with the suitability of A.A.F. airports for postwar use, a method is presented for determining the maximum density-altitude to be expected in any 10-year period at any airport in the continental United States. Density-altitude depends so much on the temperature that the maximum density-altitude will occur only when the temperature is at or near its maximum value. The investigation was therefore limited to the summer months of July, August, and September, since practically all continental United States airports have attained their maximum temperature in these months.

Protection of Nonmetallic Aircraft from Lightning. I—General Analysis. II—Lightning Conductor Materials. III—Electrical Effects in Glider Towlines. U.S., National Bureau of Standards, High Voltage Laboratory. *U.S., N.A.C.A., Advance Restricted Reports Nos. 3I10, 3J12, 4C20 (Wartime Reports Nos. W-59, W-60, W-62)*, September, October, 1943, March, 1944; 16 pp.,

fig. 5 references; 35 pp., illus. 2 references; 78 pp., illus. 14 references.

The Formation of the Semipermanent Centers of Action in Relation to the Horizontal Solenoidal Field. Jeou-Jang Jaw. *The Journal of Meteorology*, Vol. 3, No. 4, December, 1946, pp. 103–114. 11 references.

The perturbation of the middle cell of the general circulation in a baroclinic atmosphere is investigated under the assumption of horizontal, divergence-free, isothermal motion. With the introduction of the horizontal solenoidal field the velocity of the trough does not differ much from that obtained by Rossby, but the existence of a critical wave length, beyond which the perturbation will become unstable, explains to some extent the flow pattern of upper-air motions during weak-circulation weather, and also provides a means of explaining how the large-scale mixing process of air masses between different latitudes takes place. The assumption of nondivergent flow does not greatly affect the investigation of the disturbance of the horizontal motion. In the consideration of energy transformation, an interrelationship between meridional and zonal circulation is established which is in fair accordance with the synoptic and statistical calculations by other writers.

A Summary of Some Radar Thunderstorm Observations. Herbert B. Brooks. *American Meteorological Society, Bulletin*, Vol. 27, No. 10, December, 1946, pp. 557–563, figs. 6 references.

Direct observation of rain areas by radar yields new information on thunderstorm characteristics and behavior. A statistical summary of characteristics of 300 showers observed by radar at Spring Lake, N.J., June–August, 1945, is given.

Methods of Analysis for the Caribbean Region. Herbert Riehl and Elmer Schacht. *American Meteorological Society, Bulletin*, Vol. 27, No. 10, December, 1946, pp. 569–575, figs. 2 references.

A revised method for tropical analysis is proposed which permits greater utilization of recent advances in tropical meteorology than is possible with conventional methods. It is suggested that the surface map be replaced with a "basic chart" which contains wind reports from an upper level, 24-hour surface-pressure changes, and cloud and weather reports. Plotting and analysis methods for this chart are discussed. A survey is given of auxiliary charts and diagrams considered useful for tropical analysis.

Insolation in Relation to Cloud Type. Bernhard Haurwitz. *The Journal of Meteorology*, Vol. 3, No. 4, December, 1946, pp. 123, 124, figs. 1 reference. Formulas are derived for the insolation as a function of the air mass for different cloud types.

Estimating the Correlation Coefficient. H. W. Norton. *American Meteorological Society, Bulletin*, Vol. 27, No. 10, December, 1946, pp. 589, 590, table. 1 reference.

Slope Evaluation for Iso-"D" Lines on a Vertical Cross Section. Julius London. *American Meteorological Society, Bulletin*, Vol. 27, No. 10, December, 1946, pp. 590–592, figs.

Military Aviation

Science and Air Power. H. H. Arnold. *Air Affairs*, Vol. 1, No. 2, December, 1946, pp. 184–195.

The cooperative effort of the Air Forces and the aeronautical sciences which prevailed during the war must be continued and expanded. Instances of the effectiveness of such cooperation of civilian scientists and military officials include the work of the Strategic Bombing Survey, the completion of plans for the attack on Japan, the development of radar, and the establishment of the postwar office of Deputy Chief of Air Staff for Research and Development, with the Advisory Specialist Group and the Scientific Advisory Panel. To achieve the best results there must be inspired leadership and continuous study, in which the great educational institutions can perform valuable services. Unending research is vital to the safety and progress of America.

Aviation and War. James Trapier Lowe. *Air Affairs*, Vol. 1, No. 1, September, 1946, pp. 67–79.

Strategic air power is credited as the greatest single factor in the Allied victories in World War II, operating with the cooperation of the other branches of the armed services. The only effect of the atomic bomb on future war is stated to be that the increase of fire power represented by it increases the vulnerability of every country to air attack. The lack of mobility is at present a limiting factor, since it has not been established by experience that atom bombs can prevail against a country that retains control of the air above it. Future military air power may take a variety of different forms, with guided missiles, rockets, space ships, atomic-powered craft, and other developments causing revolutionary revisions in war strategy, and possibly forcing a new way of life upon nations.

The Ballistic Computer (for Testing Anti-Aircraft Gun Directors.) Joseph Juley. *Bell Laboratories Record*, Vol. 25, No. 1, January, 1947, pp. 5–9, illus.

Gun Testing Stand—Universal Type. D. Davidson. *Australia, Royal Australian Air Force, Aircraft Performance Unit No. 1, Laverton, Report, Detail No. 571/A/184*, April, 1945. 20 pp., diagrs.

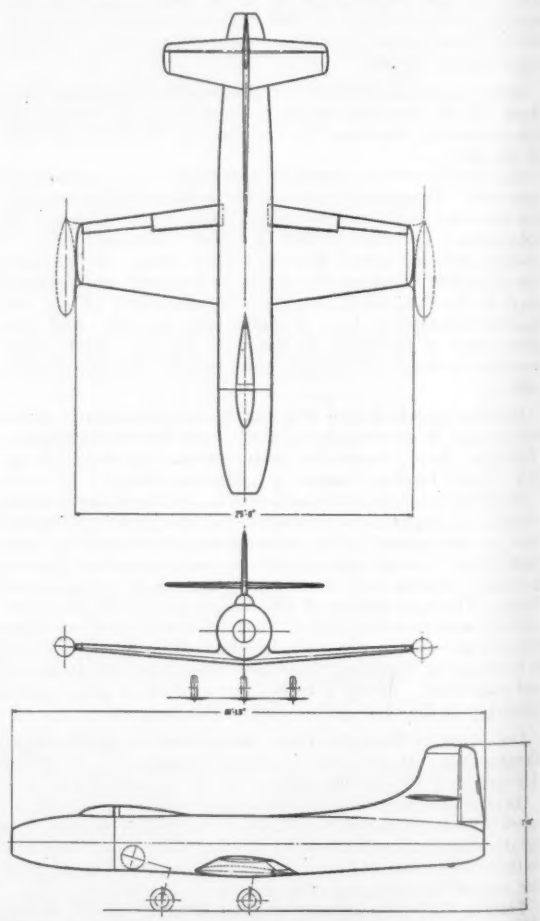
The guns that can be satisfactorily butt tested on it, after suitable modifications, are the 0.303 Browning M.G.; 0.303 Vickers G.O.M.G.; 0.50 Browning M.G.; and 20-mm. guns for Mosquito, Beaufighter, Spitfire, and Boomerang aircraft.

Low-Altitude Radar Bombsight AN/APQ-5 (Bell). J. W. Rieke. *Bell Laboratories Record*, Vol. 25, No. 1, January, 1947, pp. 13–16, illus.

Naval Aviation

War in the Pacific. R. A. Ofstie and J. A. Field, Jr. *Air Affairs*, Vol. 1, No. 2, December, 1946, pp. 196–217.

Amphibious attacks implemented by the carrier task forces are credited with a most important part in the victory over the Japanese. Land-based fighters and long-range bombers contributed to the destruction of the Japanese ability to carry on the war. Naval and Marine air forces sank 49 per cent of the tonnage of the Japanese fleet, the next largest portion being the 30 per cent accounted for by submarines. In the sinking of merchant tonnage the submarines were most effective, sinking 59 per cent



Three-view drawing of Douglas XD-558 Skystreak. (See "The Skystreak," page 45.)

of the total, with Naval and Marine aviation getting 19 per cent. The contribution of air power is traced in connection with each phase of the war in the Pacific.

Navigation

Navigation for the Many. L. D. Wing. *U.S. Air Services*, Vol. 31, No. 12, December, 1946, pp. 27, 28.

"Mental dead reckoning," a simplified method that is essentially a matter of correlating the predicted wind, the compass, and the map, is suggested as practical for the private pilot flying a small airplane not equipped with radio.

The Time and the Place. *Skyways*, Vol. 6, No. 2, February, 1947, pp. 27, 72, illus. (Cf. preceding abstract.)

Beam Bracketing for Amateur and Professional. Stanley A. Hall. *Western Flying*, Vol. 27, No. 1, January, 1947, pp. 16, 17, 38, figs. The two basic systems used to determine exactly where, between two limits on the compass, the radio beam lies, are compared. The technique of following the radio beam is explained.

Parachutes

New Monorail System Speeds Paracan Drops from Packet. *Fairchild Engine and Airplane Corp., Fairchild Aircraft Div., Release*, February 1, 1947. 2 pp., illus.

The prototype of an automatic monorail system capable of releasing 15 standard 350-lb. Army paracans in only 8 sec. is now installed on a Fairchild C-82 Packet troop carrier transport. An endless cable carries the paracans to a "tripper" directly over the paratainer door in the fuselage, where they are released and the parachute automatically opened by a rip cord attached to a static line in the ceiling of the cargo hold.

Photography

Development in the Field of Aerial Photography. Aelred A. Koepfer. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 398–412, illus. Aerial cameras and techniques employed during the war are discussed as a basis for a study of the probable trends in design.

Aerial Surveys in Highway Location. William T. Pryor. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 429–447, illus. Some of the fundamental principles relating to the use of various aerial surveying methods and types of photogrammetric equipment in highway location are described.

A Method of Determining the Depression Angle and Swing of a Terrestrial Photograph When the Apparent Horizon Is Not Imaged on the Photograph. Everett L. Merritt. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 465–480, figs.

A Derivation for the Image Displacement Due to Tilt. Michael G. Misulia. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 461–463.

Ground Photographic Equipment Design in the AAF. C. P. Owen. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 412–414.

Air Materiel Command Research on Resolution and Distortion. Paul L. Pryor. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 388–398, illus.

The Monoscope; A New Transferring Instrument for Use with Air Photographs. George R. Sonley. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 453–455.

Atomic Energy Controls. D. Jerome Fisher. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 449–451. The use of aerial photography as a control over the mining of fissionable materials.

Mapping in the Southwest Pacific. Geo. W. Hansen. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 372–375.

Application of Shoran to Photogrammetric Mapping. Gilbert G. Lorenz. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 381–385.

Experimental Investigations of Shoran for Mapping and Charting. James E. Henry. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 377, 378.

Electronics and Its Application in the Work of the Hydrographic Office of the United States Navy. Gunnar Leifson. *Photogrammetric Engineering*, Vol. 12, No. 4, December, 1946, pp. 385–387.

Production—General

Procurement of Military Aircraft by the A.A.F. in 1946. *U.S., A.A.F., Air Matériel Command, Wright Field, Dayton, O., Release*, January 16, 1947. 2 pp.

A total of 1,010 aircraft was delivered, among which were 453 fighters, over 400 of which were powered with jet units, 63 bombers, 19 photographic airplanes, 82 transports, 60 communications type aircraft, and 329 special purpose airplanes. Not included in the annual total are 15 gliders. The number and type delivered by each manufacturer are listed.

Army Planes—Today and Beyond. *Nathan F. Twining. Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 95, 212, illus.

A peacetime program of air industrial preparedness is advocated, the principal keys being continued procurement by the Army Air Forces of advanced types of military aircraft; intensive research and development; a reserve of production resources and materials; and specific production-acceleration plans for certain of the latest air weapons. Current models are described. There is a list of 19 companies holding prime A.A.F. contracts for experimental aircraft and guided missiles.

12 Firms Ship 31,594 Personal Planes in 1946. *American Aviation*, Vol. 10, No. 17, February 1, 1947, p. 29, table.

Design and Production: The Importance of Their Integration, with Particular Reference to Large Flying-Boats. C. P. T. Lipscomb. *Aircraft Production*, Vol. 9, No. 99, January, 1947, pp. 34–37.

Some of the requisites that such a constructional policy demands are close liaison between design and production departments from the inception of any new project; the building, where possible, of a small fleet of prototypes; maximum use of self-contained, independently fabricated components; and wider adoption of proved new production techniques. Notes on the ten-unit system used in building the Shetland hull are included.

Designing for Economy of Material Tooling Labor. Kenneth W. Schmidt. *Product Engineering*, Vol. 18, No. 1, January, 1947, pp. 132–136, illus.

Methods of keeping material, tooling, and labor costs at a minimum are described. Material charts are shown which have been found helpful as a guide to the design engineer in selecting the proper material. Examples are given of how tooling costs can be kept at a minimum by the proper designing of parts. Other examples show ways in which labor cost can be controlled.

Economic Aspects of Standardization. John F. Cramer. *Fasteners*, Vol. 3, No. 5, December, 1946, pp. 6–9, illus.

Buried Factory Construction Found Advantageous in Sweden. *Aviation News*, Vol. 6, No. 27, December 30, 1946, pp. 18, 19, illus.

Swedish Aircraft Engine Plant Goes Underground. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 56, 57, illus.

Production Methods

Vickers-Armstrongs Viking. I—Fuselage Design and Construction: Flexible Wing-Attachments. S. C. Poulsen. *Aircraft Production*, Vol. 9, No. 99, January, 1947, pp. 9–18, illus.

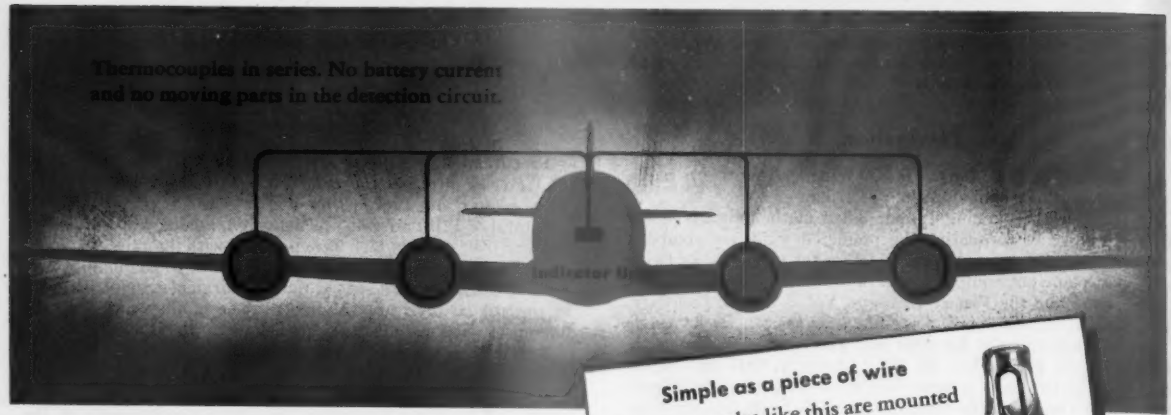
Preliminaries to full-scale production included a comprehensive tooling program. It was necessary to design and prooftest a stressed-skin wing to replace the geodetic component adopted for the first Vikings, in order to get manufacture under way as soon as possible. Design features and production operations are illustrated.

Time Cycle for Heat Treatment of Alloys Eliminates Production Delays. *The Glenn L. Martin Co., Release No. 1171*, Recd. January 23, 1947. 2 pp.

Four different alloys—53S, Alclad 14S, R-301, and 61S, are aged together at 350°F. for 8 hours, or at 340° for 10 hours. This saves at least 40 hours of furnace time each week and eliminates the use of more than one furnace.

Induction and Dielectric Heating. Kennard Pinder. *Electrical Engineering*, Vol. 66, No. 2, February, 1947, pp. 149–160, figs. 8 references.

The fundamental principles are outlined, and various types of operations where the methods can and are being used to save time, cost, equipment, and material are pointed out. Some data



Simple as a piece of wire

Thermocouples like this are mounted in potential fire zones. Each is just a piece of wire connected in series. Only a fire can make it send an alarm signal.

Only EDISON makes the thermocouple type.

How EDISON thermocouple fire detection meets ideal requirements

[ITEM VIII-A-1 OF REPORT NO. 2 *of Aircraft Industries Association ARC Subcommittee on Aircraft Fire Detection, Airworthiness Project No. 7, dated May 27, 1946, lists requirements for the ideal fire detector. See how the performance of the Edison system compares with these ideal requirements.*]

The IDEAL Detector (From ARC Report)

"a. Should be ruggedly constructed so as to resist exposure to gasoline, oil, dirt, water, vibration, fatigue, salt air, and handling.

"b. Detector circuit should require no current until the actual alarm has signalled, unless a supervisory system is used.

"c. It should fail safe, i.e., in case of circuit failure it becomes inoperative rather than give a false alarm.

"d. A test button should be provided to check the entire system.

"e. There should be no moving parts in the circuit.

"f. The detector should be able to withstand more than one fire without having to be replaced or calibrated.

"g. The detector should indicate when the fire is extinguished."

The EDISON Detector

a. It is RUGGED and AMAZINGLY SIMPLE . . . just a piece of wire that is mounted in each potential fire zone . . . that's all there is to a thermocouple.

b. Thermocouple detectors require no battery current. They generate their own current, and they send a "FIRE" signal *only when there is a fire.*

c. Should a thermocouple circuit fail, it could send no signal . . . couldn't give a false alarm.

d. The push of a button checks the entire Edison system.

e. There are no moving parts of the system in the fire zones. The only moving parts are the relay contacts located in the signal system.

f. Thermocouple detector will withstand many fires without need for replacement or calibration.

g. A thermocouple detector signals "FIRE OUT" and is again ready to signal "FIRE" after conditions return to normal.

THOMAS A. EDISON, INCORPORATED
INSTRUMENT DIVISION
105 Lakeside Ave., West Orange, N. J.

EDISON AIRCRAFT SYSTEMS and INSTRUMENTATION

are supplied on the different types and sizes of induction heating units.

Radiography of Spot Welds in Various Sheet Gages and Dissimilar Gage Combinations. R. C. McMaster, F. C. Lindvall, and L. P. Gaard. *The Welding Journal*, Vol. 26, No. 1, January, 1947, pp. 19–29, figs. 6 references.

Extensive tests of spot-weld radiography were made for spots welded with energies varying from the minimum to the maximum feasible, in two-layer equal-thickness combinations of 24ST Alclad aluminum alloy in all commercial gages from 0.020 to 0.156 in. Similar tests were made for welds in dissimilar thickness combinations of 0.040-in. 24ST Alclad aluminum-alloy sheets with each available gage from 0.040 to 0.188 in. It was found that all features of the radiographic images could be interpreted correctly by a logical extension of the methods of interpreting radiographs of spot welds in 0.040–0.040-in. sheets described in previous papers.

A Survey of Engineering Radiography. V. E. Pullin. *The Engineer*, Vol. 183, No. 4748, January 10, 1947, pp. 40–42.

Inspecting Turbosupercharger Blades by "Pant-O-Jector" Optical Projection Comparator. E. C. Polidor. *The Iron Age*, Vol. 159, No. 3, January 16, 1947, pp. 40–44, illus.

Inspecting and Measuring Jet-Propulsion Blades. *Machinery*, Vol. 53, No. 5, January, 1947, pp. 185–188, illus. The use of the Pant-O-Jector optical projector.

Production of Flat Surfaces: Comparative Examination of Some Surfaces Obtained by Various Machine-Tool and Hand Methods. R. J. M. Whibley. *Aircraft Production*, Vol. 9, No. 99, January, 1947, pp. 19–24, figs.

Lofting Methods in Practice. S. P. Woodley. *The Aeroplane*, Vol. 71, No. 1857, December 27, 1946, p. 765. (Extended abstract of a paper.)

Descriptions and comparisons of the different methods of reproducing full-scale lines on metal sheets: the photographic, electrolytic, and lithographic processes. The reproduction and use of templates is also discussed.

Cardboard Mock-Ups (of Machine Parts). Morton P. Matthew. *Product Engineering*, Vol. 18, No. 1, January, 1947, pp. 120–122, illus.

Microfilm as an Engineering Tool. E. S. Kopecki. *The Iron Age*, Vol. 159, No. 3, January 16, 1947, pp. 46–48, illus. Its applications in filing and storing drawings and other records.

Roll Bending and Flash Welding Stainless Steel Turbosupercharger Rings. P. B. Scharf. *The Iron Age*, Vol. 159, No. 4, January 23, 1947, pp. 52–56, illus.

A method of producing the rings from bar stock of standard or special sections provides worth-while cost savings when quantities are sufficient to justify line-production technique. A high degree of accuracy in ring dimensions is obtainable.

Heliarc Welding of Light Metals. H. T. Herbst. *Modern Metals*, Vol. 2, No. 12, January, 1947, pp. 26–28, illus. (Extended abstract of a paper.) The development of heliarc welding is reviewed and details are given about the process and its various production applications.

New Oxygen-Arc Process for Cutting Ferrous and Nonferrous Alloys. H. R. Clauser. *Materials & Methods*, Vol. 25, No. 1, January, 1947, pp. 78–81, illus. (Cf. AER 1/47:56.)

A New Stick Feeder Welding Apparatus. Joseph M. Tyrner. *The Welding Journal*, Vol. 26, No. 1, January, 1947, pp. 13–16, figs.

A simple device developed to enlarge the field of automatic welding is designed to feed the electrode into the arc, maintain a proper arc length, and move the arc spot along a predetermined path to lay down a bead.

Recommended Spotwelding Procedures. Frederick S. Dever. *The Iron Age*, Vol. 159, No. 5, January 30, 1947, pp. 46–50, illus.

Four suggestions regarding conditions for good design are enumerated. Spot-weld patterns which are important in the design of spot-welded structures are classified. Other sections deal with the materials that can be welded, the preparation of the weld, and welding equipment.

Production Tools and Equipment

A Fully Automatic Welding Machine for the J33 Jet Engine Wheel and Shaft. *General Motors Corp., Allison Div., Release*, Recd. January 23, 1947. 1 p., illus.

In joining these parts together, the welder automatically goes through three continuous cycles. The parts are positioned in the machine, the end of the shaft in line with a stub shaft on the wheel. As the ends are gradually made to touch, current of about 60,000 amp. is passed through each part. When the temperature reaches 2,600°F. the wheel and shaft faces become soft. The upset occurs during the last 4 sec. of the 3-min. welding cycle, when 240,000 lbs. of hydraulic pressure and over 60,000 amp. are exerted, welding the two parts together into a permanent single unit. Some mechanical and heat-resistant properties of the steels used in the wheel and shaft are given.

Illustration Courtesy Wright Aeronautical Corporation

Use of a radial drill head for drilling oil passages on the inside of an engine nose section is dictated by the necessity for swinging the head out of the way to remove the workpiece. (See "Jig-Drills Reduce Capital Outlay, Eliminate Setup Time.")

Jig Drills Reduce Capital Outlay, Eliminate Setup Time. E. Prange. *The Iron Age*, Vol. 159, No. 2, January 9, 1947, pp. 42–45, illus.

Combining small standard drill heads with the drill jigs has reduced time and expense in the manufacture of certain Wright aircraft-engine parts requiring hundreds of holes of various depths, diameters, and angles. Designated as jig drills, these inexpensive units were originally designed to offset the critical wartime shortage of radial drills. On some of the jig units the power head is a small radial drill of standard design which swings away to permit indexing or removal of the part being machined. On others the power heads are in a fixed position. A series of jigs or fixtures is devoted to each type of part to be worked, and the number of jigs in each series is determined by the number of operations necessary to complete drilling of all holes.

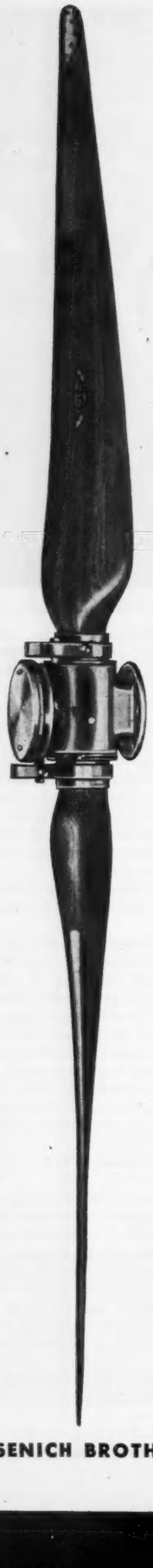
New Ultrasonic Materials Tester Introduced by G.E. *General Electric Co., Release*, Recd. January 13, 1947. 2 pp.

The tester is designed to detect internal flaws in metals, plastics, and ceramics. It consists of a complete wide-band ultrasonic transmitting-receiving system having a high-frequency generator, a crystal transducer for producing ultrasonic vibrations, a satisfactory medium such as water to transmit these vibrations, and a second crystal transducer to convert the received mechanical energy into electrical signals. Internal flaws will produce measurable decreases in total transmission of waves through the specimen and a consequent drop in the indicator reading.

A New Horizontal External Comparator for Inspection and Gage Laboratory. *The Sheffield Corp., Release*, January 8, 1947. 1 p., illus.

For the quick, accurate measurement of rectangular, threaded or cylindrical parts, tapered or straight, within millionths of an

THE PROPELLER WITH PERFORMANCE



SOMETHING *New* ON THE NOSE

OF THE *New* SUPER CRUISER

Crowds thronged around the new Piper Super Cruiser at the great National Aircraft Show.

They thronged, too, at the Sensenich booth where a demonstration cutaway model of Sensenich Brothers new SKYBLADE was being shown for the first time. Engineers, designers, pilots praised the simple, practical design of this lightweight, two-position controllable pitch propeller.

Now purchasers of the Piper Super Cruiser can enjoy either the propeller performance of a Sensenich fixed pitch propeller which is standard equipment or the new controllable SKYBLADE as special equipment. It's just a matter of changing the prop.

For more than a quarter of a century Sensenich has concentrated its production on high quality wood propellers only. There is scarcely a pilot who hasn't flown behind a Sensenich. This *proof by performance* has made Sensenich Brothers the world's largest manufacturer of wood aircraft propellers.

A and E MECHANICS! If you are interested in attending a three-day course covering the assembly, disassembly, balance and inspection of Sensenich SKYBLADE propellers at our Lancaster, Pa., plant, please write us.

SENSENICH Skyblade

REPAIR SERVICE. If your wood propeller needs repairing, send it to the Sensenich PROP SHOP. Any make. Prompt and efficient service. Denver and West please use Glendale plant.

SENSENICH BROTHERS • Main Plant, LANCASTER, PA. • West Coast Branch, GLENDALE, CALIF.

inch, the new Sheffield comparator has an adjustable pressure attachment, elevating table, and Electrigage head available in amplifications of 100-1, 2,500-1, or 5,000-1. Use of the micrometer tailstock in applications below 1 in. permits readings of 0.0001 in. from the calibrated barrel without the use of gage blocks or masters.

"Airlectric" Automatic Gaging Machine. *Sheffield Corp., Release*, January 21, 1947. 1 p., illus. The machine checks the average outside diameter of shock-absorber pistons and segregates them into eight classes, at the rate of 3,600 per hour.

At the Paris Show; Some Notes on Matters of Production Interest. *Aircraft Production*, Vol. 9, No. 99, January, 1947, pp. 3–8, illus.

Propellers

Flight Investigation at High Speeds of the Drag of Three Airfoils and a Circular Cylinder Representing Full-Scale Propeller Shanks. William H. Barlow. *U.S., N.A.C.A., Technical Note No. 1129*, September, 1946. 27 pp., figs.

Tests were made at high speeds to determine the drag of models, simulating propeller shanks, in the form of a circular cylinder and three airfoils, the NACA 16-025; the NACA 16-040; and the NACA 16-040 with the rear 25 per cent chord cut off. The models were supported perpendicular to the lower surface of the wing of an XP-51 airplane. A wake-survey rake mounted below the wing directly behind the models was used to determine profile drag at Mach Numbers of 0.3 to 0.8 over a small range of angle of attack. The drag of the cylinder was also determined from pressure distribution and force measurements. The drag reduction obtainable through the use of these airfoil sections in place of a round shank increased with a decrease in airfoil thickness ratio, and reached maximum values at a Mach Number of 0.63 for the NACA 16-040 airfoils and 0.71 for the NACA 16-025 airfoil.

Proposal for a Propeller Side-Force Factor. Herbert S. Ribner. *U.S., N.A.C.A., Restricted Bulletin No. 3L02 (Wartime Report No. L-336)*, December, 1943. 13 pp., figs. 3 references.

Theory of the Propeller 'Fin' Effect, Including a Review of Existing Theories. E. Priestley. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 2030*, August, 1943. 20 pp., figs. 9 references. British Information Services, New York. $1.20.

Following a review of existing theories, a new theory is developed and compared with those due to Rumph and Hufton. Numerical comparisons of the three theories are made, based on calculations of the propeller "fin" effect for dive and climb conditions (full power) and for dive and slow glide (zero power); for all these conditions the propeller was completely installed. The interference effects between the propeller and the rest of the aircraft are not considered. A formula is established giving the side force on a yawed propeller as proportional to the integral over one blade of an explicit function of the lift, drag, effective aspect ratio, and lift-curve slope at a blade element, the two latter parameters being simply determined by use of given charts. Induced and oscillatory effects are allowed for, and the form of the result facilitates also an allowance for compressibility should this be necessary. Various exceptions and limitations applicable to the new theory and suggested modifications of earlier calculation procedures are set forth.

Coupled Flexural Vibrations of the Blades of a Propeller and Torsional Vibration of an Engine Crankshaft System. J. Morris and J. W. Head. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2011*, October, 1942. 37 pp., figs. 4 references. British Information Services, New York. $1.90.

A theoretic method for calculating the natural frequencies and modes of vibration of actual propeller blades in which the variation in section and twist are taken into account in addition to the effect of rotation. Consideration is also given to the vibrations that occur when a propeller is coupled to an engine. The main features of the method are (1) the replacing of the continuous propeller by a series of discrete masses; and (2) the application to this system of masses of the deflection coefficient treatment specially adapted to take into account the variation in twist as well as in section. The numerical solution of the equations of motion has been greatly facilitated by the "escalator" method evolved in the course of research. The analysis can be applied in the design stage. A fully worked-out numerical example is given relating to a three-way variable-pitch propeller used in practice. The calculated fixed root frequencies for the fundamental and six overtones accorded closely with the values evidenced on a $^1/_{10}$-scale model of the blade by bowing and calibrated oscillator tests carried out subsequent to the calculations.

Note on Contra-Rotating Propellers. P. A. Hufton. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 1938*, March, 1939. 8 pp., figs. 17 references. British Information Services, New York. $0.60.

This note reports the results of an examination of existing information relating to the comparative weights and efficiencies of counterrotating propellers, and information about the effects of the propeller on the control of the aircraft. The counterrotating propeller is found to provide a solution to the aerodynamic problem of increasing the solidity without adverse effects on the control. The properties of that type of propeller are summarized to show that slipstream rotation and gyroscopic effects on the control are eliminated, and it is possible to increase the solidity of the propeller without ill effects. If the solidity of the propeller is doubled, the diameter and blade weight can be reduced and propulsive efficiency can be increased, although there will be a small reduction of take-off thrust.

The Propeller Aspect of Practical Problems in Reducing Noise in Personal Planes. Leslie J. Trigg. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 6 pp., figs.

The general problem can be most efficiently attacked from the standpoint of reducing the propeller-tip speed. Design features contributing to such a study include the airfoil type used, the thickness-chord ratio, the surface texture, the operating angles of attack, and the operating values of advanced ratio coefficient. Solutions are to be found in lower engine speeds, reduction gearing, multibladed propellers, wider blades, or a combination of these. Factors governing the adoption of these remedies are discussed, and charts are presented to show the relationship of engine power and airplane speed, with propellers of two and four blades, at tip speeds of 700 and 800 ft. per sec. Another chart and a formula may be used to compute propeller speeds corresponding to selected values of power, air speed, and propeller diameter.

Propeller Requirements for Light Aircraft. John F. Haines. *Preprint, S.A.E. Annual Meeting*, Detroit, January 6–10, 1947. 16 pp., figs.

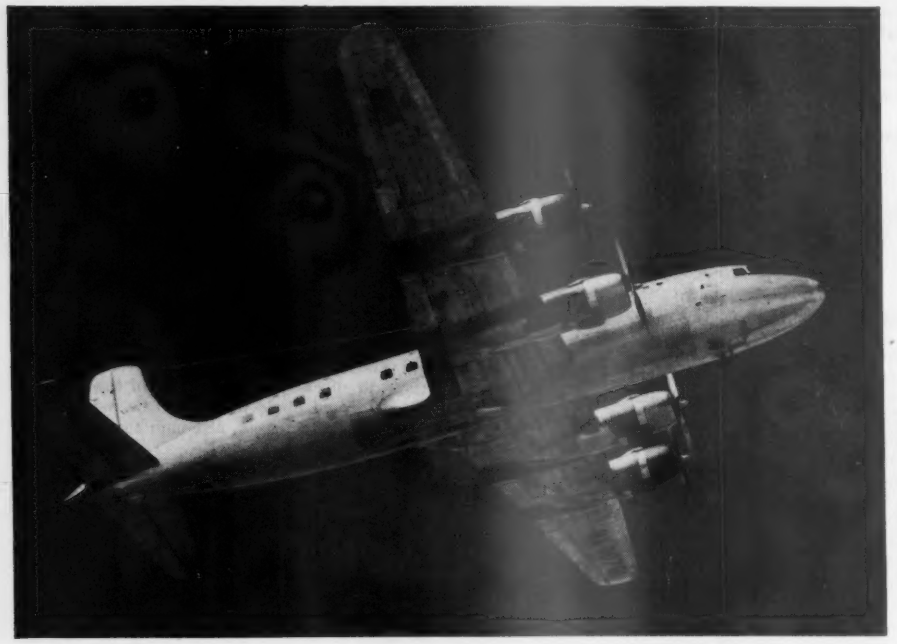
The operating characteristic of various propeller-engine combinations are analyzed and means are suggested for the improvement of the performance of light aircraft. Consideration is given to the factors of cost, weight, and safety. For purposes of discussion particular attention is given to two aircraft of typical design, one a two-place type having a gross weight of 1,400 lbs., and the other a four-place design having a gross weight of 2,550 lbs. The performance of a larger multiengined aircraft also is discussed. For most cases, controllable-pitch propellers are recommended for optimum performance. A constant-speed or selective-speed design is usually warranted for airplanes of lighter wing loading and lower power loading.

Propellers—Today and Beyond. George W. Brady. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 121, 219, illus.

Military aircraft operating at 550 m.p.h. or less will continue to use propeller propulsion, and for the 550–700 m.p.h. range specific requirements will govern the choice of jet or propeller. In the transport field, major improvements include higher-solidity blades, reverse thrust, automatic synchronization, better deicing systems, and less noise.

Duplex Airscrews. I, II. C. B. Bailey-Watson. *Flight*, Vols. 50, 51, Nos. 1983, 1984, December 26, 1946, January 2, 1947; pp. 693–698, illus.; pp. 3–6, diagrs.

A review of coaxial and counterrotating propeller drives. I. The design of the Bristol 167 power installation is discussed as representative of the coaxial arrangement. The installation comprises four pairs of Centaurus engines, the individual units of each pair being angularly disposed one to the other so that their crankshaft axes center at a vertex angle of 64°. The crankshafts drive torsion shafts which, in turn, drive bevel pinions meshing with bevel wheels carried on the respective airscrew shafts. The latter are nested coaxially, the outer shaft carrying and driving the rear propeller and the inner shaft carrying and driving the front propeller. It involves the use of only a single pair of reduction bevel gears for each engine-propeller drive, thus incurring the lowest transmission loss. Details are given about the gear box, bevel-drive cooling, and propeller operation



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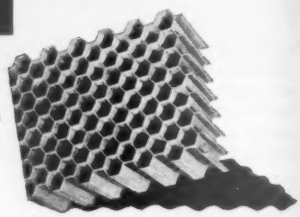

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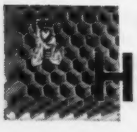

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and control. **II.** Details of the Rotol six-blade hydraulic counterrotating propeller as used with the Rolls-Royce Griffon 85 engine of the Spitfire 22, including the design of the hubs, method of pitch change, and constant-speed unit.

Technical Data on Electrical De-Icing by Hamilton Standard Propellers. *United Aircraft Corp., Hamilton Standard Propellers Div., Release,* February 17, 1947. 2 pp.

Hamilton Standard's new electrical deicing system is used internally with the hollow steel blade and externally with duralumin blades. The hollow steel blade is deiced by current applied to special alloy heater wires cemented to the inside surface of the blade's leading edge. For duralumin blades the heating element consists of three layers of different rubber types mounted externally on the leading edge, the middle layer of conductive rubber supplying the heat by its electrical resistance. In both blade installations, the heated section covers approximately 75 per cent of the blade length and 20 per cent of the width extending from the leading edge.

1947 Annual Directory of Aircraft Propellers. *Aero Digest,* Vol. 54, No. 1, January, 1947, pp. 122–124, 126, 128, 130–132, illus. Specifications of 63 propellers.

Radio

Raydist—A Precision Radio Navigation and Tracking System. Charles E. Hastings. *Paper presented at I.A.S. 15th Annual Meeting,* New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 38 of this issue, March, 1947.)

Radio Controlled Flight. *Radio News,* Vol. 37, No. 1, January, 1947, pp. 25–27, 137–139, illus.

A description of the electronic equipment used to control drone planes. Functional diagrams show the conversion unit and transmitter used in the drone plane; the transmitter radio receiver and selector; and the television receiver used in the "mother" plane.

Airport Control Towers to Use New Very High Frequency. *U.S., Civil Aeronautics Administration, Release,* December 31, 1946. 2 pp.

The traffic-control towers of the C.A.A. have begun the transition to the new V.H.F. band of 122.5 megacycles for private flying. The only additional equipment needed by the private owner is the crystal for the fixed-tuned receivers. Conversion of the estimated 150 to 200 sets of V.H.F. airplane radio transmitters now in use from 131.9 to 122.5 megacycles can be accomplished for about $30 each, according to manufacturers.

Simulation of the Characteristics of Direction Finder Antennas. Wayne E. Rife. *Ohio, University, Engineering Experiment Station, News,* Vol. 18, No. 5, December, 1946, pp. 12–18, figs.

Even in aircraft direction-finder equipment of the best design, inherent errors are found in obtaining bearings. Among these are the so-called "polarization" errors, and it is because of such errors that an additional item of vital importance—the calibration data of the equipment—is needed before useful results can be obtained. Methods are described which were developed to obtain such calibration data and from them to predict the usefulness of certain proposed installations of equipment.

Accuracy of Antenna-Pattern Measurements. Robert A. Fouty. *Ohio, University, Engineering Experiment Station, News,* Vol. 18, No. 5, December, 1946, pp. 19–24, illus.

The requirements, techniques, and methods used to prove that antenna patterns measured by the model technique (with the antenna on the model acting as a receiving antenna) are accurate.

Miniature Antennas—A New Tool for the Antenna Designer. George Sinclair. *Ohio, University, Engineering Experiment Station, News,* Vol. 18, No. 5, December, 1946, pp. 3–7, illus. The use of scale model airplanes equipped with miniature antennas as a means for determining the radiation and receiving characteristics of aircraft antennas.

Equipment for Determining Aircraft Antenna Characteristics. David C. Cleckner. *Ohio, University, Engineering Experiment Station, News,* Vol. 18, No. 5, December, 1946, pp. 7–12, illus.

A description of the equipment and methods employed for the measurement of aircraft antenna patterns through the use of scale model airplanes. When antennas are used as a part of an instrument such as a homing device, as a radio compass, or as a command antenna, it is necessary to know in which directions the antenna will best radiate or pick up energy and to what extent the amplitude of the signal varies.

Radiation Patterns of Ground-Based Antennas. Robert B. Jacques. *Ohio, University, Engineering Experiment Station, News,* Vol. 18, No. 5, December, 1946, pp. 24–33, figs.

A description of a rapid and fairly accurate method of measuring the space-wave radiation characteristics of the antenna for ground-based tactical radio sets used by the Army Ground Service Forces. Aircraft flying radially over the test location are used to transmit signals to the comparison and standard antennas.

Construction of Models. Paul H. Nelson. *Ohio, University, Engineering Experiment Station, News,* Vol. 18, No. 5, December, 1946, pp. 33–36, illus.

The construction of model airplanes for use in the measurement of antenna radiation patterns is described. Particulars are given about wood carving and metal-forming operations.

Radar Paints a Picture. I, II. *The Aeroplane,* Vols. 71, 72, Nos. 1852, 1858, November 22, 1946, January 3, 1947; pp. 631, 634–636; pp. 10–13; diagrs.

I. Explains how a picture of the ground below an aircraft is produced with radar equipment. **II.** Describes the first navigational use of radar navigation and the technique gradually developed. Details are given about British radar equipment and its use in bombing and in commercial flying. Such later developments as Ground Controlled Approach and the Airfield Surface Movement Indicator also are explained, and a forecast is made of the future use of such equipment.

The History of Shoran. H. G. Sennert. *Photogrammetric Engineering,* Vol. 12, No. 4, December, 1946, pp. 375, 376.

Tactical Use of Shoran and Accuracy Obtained. Carl I. Aslakson. *Photogrammetric Engineering,* Vol. 12, No. 4, December, 1946, pp. 379–381, tables.

Rotating Wing Aircraft

C.A.A. Testing of Helicopters. Ralph B. Lightfoot. *Paper presented at I.A.S. 15th Annual Meeting,* New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 38 of this issue, March, 1947.)

Helicopter Power-Plant Installations. Robert A. Wolf and Carl P. Spiesz. *Paper presented at I.A.S. 15th Annual Meeting,* New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 38 of this issue, March, 1947.)

Figure of Merit. N. de Transche. *American Helicopter,* Vol. 5, No. 11, January, 1947, pp. 11, 12, 33, 34, 36.

The figure of merit used in helicopter design should be defined as the total efficiency of a blade of the lifting rotor. The importance of the figure of merit to the design of a helicopter as a whole has been overestimated, while its real importance in the design of rotors has been neglected. For a full appreciation of its importance, the figure of merit must first be modified and brought into its proper and normal form by deducting it from the primary concept of the phenomena of the flow created by a lifting rotor. A mathematical proof of this statement is included.

Check Those Blades. Arthur Schouw. *American Helicopter,* Vol. 5, No. 11, January, 1947, pp. 29, 30, 41, figs.

A discussion of factors involved in the balancing of helicopter rotor blades of different designs, and of the problems caused by lack of balance.

Practical Engineering of Rotary Wing Aircraft. VII. John E. McDonald. *Aviation,* Vol. 46, No. 1, January, 1947, pp. 62, 63, 114, 115, figs. 3 references. (Cf. AER 2/47:68.) An analysis of resonant oscillations in the plane of rotation, blade natural frequencies, ground resonance, and critical speed.

Response of Helicopter Rotors to Periodic Forces. Bartram Kelley. *U.S., N.A.C.A., Advance Restricted Report No. 5A09 (Wartime Report No. W-49),* March, 1945. 16 pp., figs. 5 references.

Helicopters—Today and Beyond. Igor I. Sikorsky. *Aero Digest,* Vol. 54, No. 1, January, 1947, pp. 85, 209–211, illus.

The year 1946 marked the beginning of the commercial and other nonmilitary uses of the helicopter. Simplification of controls, with certain functions exercised by automatic governors, continued use of the single lifting rotor, and greater accessibility for repair and maintenance operations are indicated for future models.

Canadian 'Copter. Bernard W. Sznycer and Selma G. Gottlieb. *Aircraft and Airport,* Vol. 8, No. 12, December, 1946, pp. 28–30, 32, illus.

Features of the S.G. Mark VI helicopter designed by the writers for the Intercity Airline Company of Montreal are described.

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The requirements were that the helicopter could be built in Canada, could fulfill the specific functions characteristic of the vast "bush" territory of Northern Canada, and in addition, be suitable for possible use as a short-range feeder-carrier or as a trainer. Particulars are given about the rotor, torque propeller, and the engine mounting.

Low Cost Helicopter Nearing Completion; Hamilton Firm in Baltimore Hopes to Market Two-Place, 125 hp. Helicopter for "Around $5,000." *Aviation News*, Vol. 6, No. 27, December 30, 1946, p. 19. Descriptive.

The Bell Model 74 Helicopter. Dexter Rosen. *The Aeroplane*, Vol. 72, No. 1861, January 24, 1947, pp. 101, 102, diagr. Descriptive.

Helicopter Glider. *Aviation News*, Vol. 6, No. 27, December 30, 1946, p. 16, illus.

The W-Copter, a single-place rotating wing glider, is awaiting flight tests by Harris L. Woods, of Dover, Pa., the designer. Fully loaded the craft weighs 285 lbs., has a rotor of 17 ft. diameter, and steerable nose-wheel type landing gear.

Austrian "Flying Belt." *Aviation News*, Vol. 6, No. 27, December 30, 1946, p. 15, illus.

Paul Baumgartl, of Vienna, has designed a two-blade helicopter device weighing 30 lbs., which is strapped to the operator's back. It is claimed that it will climb to 3,000 ft.

Military Prototypes. XXVII—The Rotaplane 11/42. *The Aeroplane Spotter*, Vol. 7, No. 178, December 26, 1946, p. 308, illus.

Description of a controllable rotating wing glider designed by R. Hafner and the Airborne Forces Experiment Establishment. Development ceased in 1943.

New Surveying Methods in Northern Canada. *The Engineer*, Vol. 182, No. 4745, December 20, 1946, p. 560.

A mining engineer is using helicopters in a new, detailed type of aerial exploration of the uncharted regions of Northern Canada. A 16-sq.mile area that would require 6 months to chart by land methods was mapped in 2 hours.

How to Fly a Helicopter. *Flying*, Vol. 40, No. 2, February, 1947, pp. 43–48, 80, illus. Instructions on the operation of the Bell Model 47B helicopter.

1947 Annual Directory of Rotary Wing Aircraft. *Aero Digest*, Vol. 54, No. 1, January, 1947, pp. 87, 89, 91, 93, illus. Specifications of over 20 aircraft.

Seaplanes and Flying Boats

The Flying Boat and Its Commercial Uses. Peter G. Masefield. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 37 of this issue, March, 1947.)

Static Stability Analysis for Flying Boats and Seaplanes. II. Ernest G. Stout. *Aviation*, Vol. 46, No. 1, January, 1947, pp. 58–60, figs. (Cf. AER 2/47:36.)

Water-plane inertia and the effect of free liquid surface on stability are discussed. Since the water-plane area depends upon the geometry of the hull in question and varies with each specific problem, the derivation of the moment of inertia of areas is set forth. Accepted procedures available to the designer for calculating this value are reviewed. Methods are given also for computing the influence of the weight of the fuel and for providing baffles in the tanks to minimize those destabilizing factors.

Stress Analysis and Structures

The Dynamics of a Swept Wing. Herbert R. Lawrence, Adam T. Zahorski, and William E. Cox. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 39 of this issue, March, 1947.)

Computation of Influence Coefficients for Aircraft Structures with Discontinuities and Sweepback. Samuel Levy. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 39 of this issue, March, 1947.)

Numerical Methods for the Calculation of Elastic Instability. Bruno A. Boley. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 39 of this issue, March, 1947.)

Column Characteristics of Sandwich Panels Having Honeycomb Cores. W. W. Troxell and H. C. Engel. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 39 of this issue, March, 1947.)

Inelastic Column Theory. F. R. Shanley. *Paper presented at I.A.S. 15th Annual Meeting*, New York, January 28–30, 1947. (For abstract see "I.A.S. Briefs" on page 39 of this issue, March, 1947.)

A Relaxation Procedure for the Stress Analysis of a Continuous Beam-Column Elastically Restrained Against Deflection and Rotation at the Supports. Pai C. Hu and Charles Libove. *U.S., N.A.C.A., Technical Note No. 1150*, October, 1946. 74 pp., figs. 3 references.

A method of stress analysis is presented for a continuous beam column supported by deflectional and rotational springs. The principal feature of the method is the use of a relaxation procedure to determine the deflections and rotations of the supports. The shears and moments at the supports and between the supports can then be calculated with the aid of simple equations and graphs. An example is given to illustrate the use of the method.

The Effect of Elastic Suspension on the Natural Frequencies of a Uniform Wing. R. W. Traill-Nash. *Australia, Council for Scientific and Industrial Research, Division of Aeronautics, Report No. SM. 76*, August, 1946. 21 pp., figs. 4 references.

In ground vibration tests of aircraft wings it is customary to suspend the aircraft from the center section of the wings. The suspension imposes a constraint on the system which serves to increase the natural frequencies. The extent to which the frequencies are increased above those of the free-free case seems not to be generally known and, in a simplified form, this problem forms the subject of this report. For the case of a uniform beam with a concentrated mass at the center, curves are obtained showing the fractional error of measured natural frequencies under conditions of elastic suspension as compared with those of the free-free system. The effect of variation of the stiffness of suspension is shown for different values of the central mass. Particularly for the fundamental mode of a beam with small central mass, the curves show that when suspended there is a danger of serious overestimation of the frequencies. An indication of a possible method of attack for the more general problem of suspension of a nonuniform wing is given.

Flat Sandwich Panels Under Compressive End Loads. D. Williams, D. M. A. Leggett, and H. G. Hopkins. *Gt. Brit., Aeronautical Research Committee, Reports and Memoranda No. 1987*, June, 1941. 24 pp., figs. 4 references. British Information Services, New York. $1.35.

A theoretic investigation of the possibilities of sandwich panels for transmitting compressive end loads, and their behavior under such conditions. The sandwich filling is designed to be stiff enough in shear to exploit the superior strength of the faces when the panel bends as a unit, and also to provide sufficient support against premature crinkling of the faces. Combinations are discussed in which steel or duralumin forms the faces, and onazote, balsa wood, or plywood provides the filling. It is concluded that of the various types of sandwich considered, those having duralumin faces and a balsa wood filling are the most efficient. Recent experimental work has shown that the strength-weight efficiencies of sandwich and sheet-stringer panels under compressive end loads are similar. The former, however, does possess the important advantage of maintaining a smooth surface up to the point of failure.

Temperatures and Moisture Contents Attained by Wooden Aircraft in Service in Australia. W. L. Greenhill. *Australia, Council for Aeronautics, Report No. ACA-23*, April, 1946. 64 pp., illus. 10 references.

To obtain information for studies of the strength of timber, glues, preservatives, and finishes, Anson and Mosquito airplanes were tested on the ground and in flight at Melbourne, Cairns, and Alice Springs. Temperatures reached a maximum of 90°C., and showed considerable gradients from top to bottom surfaces of wings; the insulating value of the thicker plywood and double skin of the Mosquito accounted for lower temperatures inside the structure. Moisture contents varied from 3.1 to more than 20 per cent. Flight tests revealed rapid cooling of wing outer surfaces and comparatively slower cooling of spars, with little change in moisture content. Aluminum finishes with high infrared re-

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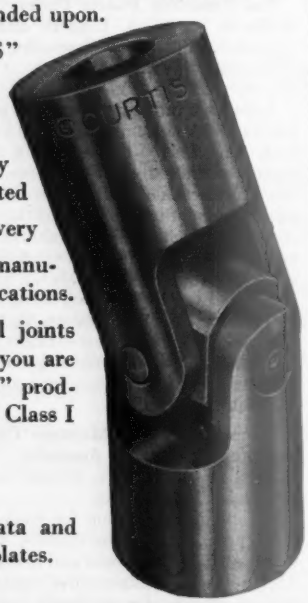

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flectance were effective in preventing high temperatures, and proprietary coatings were somewhat better than standard paint. Laboratory tests of the loosening of screws and brads in wings subjected to moisture-content changes failed to find means of eliminating the trouble, but suggestions are made which may help to reduce it.

Temperature Measurements on a Beaufort Aircraft During Summer at Alice Springs and Melbourne. G. J. Dailey and F. A. Dale. *Australia, Council for Aeronautics, Report No. ACA-26*, July, 1946. 12 pp., figs. 5 references. (*See* AER 2/47:69.)

Charts for Circular Diaphragm Design. George P. Sutton. *Product Engineering*, Vol. 18, No. 1, January, 1947, pp. 167, 169, figs.

Design information for circular thin diaphragms, of uniform thickness and with fixed edges, subjected to a uniformly distributed load. One chart is used to determine the stresses, the other for deflections for a given material and given dimensions.

Strength Testing Douglas DC-6. Milton A. Miner. *Automotive and Aviation Industries*, Vol. 96, No. 2, January 15, 1947, pp. 22, 23, illus.

Stress Engineering. Gilbert C. Close. *Air Trails*, Vol. 27, No. 5, February, 1947, pp. 28–31, 88–91, illus. A description of methods and instruments.

Types of Strain Measuring Devices and Their Range of Utility. Karl F. Smith. *Product Engineering*, Vol. 18, No. 1, January, 1947, pp. 107–110, illus. Includes a table of the characteristics of 22 instruments.

Wind Tunnels and Laboratories

Calibration Tunnel for High Speed. J. Pretsch. (*Göttingen, Aerodynamische Versuchsanstalt.*) *U.S., N.A.C.A., Technical Memorandum No. 1103*, October, 1946. 2 pp., illus.

The principal characteristics of a tunnel for testing measuring instruments at speeds up to Mach Number 0.7. It has a cylindric test section of 200-mm. diameter, with a maximum speed of 250 m. per sec.

Weather Testing Laboratory. *U.S., Army Air Forces, Air Matériel Command, Release*, December 20, 1946. 3 pp.

A testing laboratory being built at Wright Field will provide equipment for testing aircraft accessories under the most severe climatic conditions. Although much of the new equipment was designed for testing of conventional aircraft parts, facilities for testing jet-plane and guided-missile accessories also are being installed. To determine the effects of vibration, the laboratory is procuring an accelerator, or centrifuge, which will be the largest of its kind ever built. It will be equipped with television for visual observation of test articles subjected to high sustained acceleration. With this equipment engineers will be able to test aircraft accessories weighing as much as 200 lbs. Effects of the following weather phenomena can be studied in the laboratory: altitude, high and low temperatures, humidity and aridity, sun and rain, fungus growths, salt fog, sand, and dust.

Climatic Hangar Nears Completion. *U.S., War Dept., Release*, January 19, 1947. 2 pp.

In the A.A.F. climatic hangar and test room for full scale aircraft and equipment testing, controllable temperatures between −70° and 165°F. can be produced and maintained at any time. Provisions have been made for simulated wind storms or velocities up to 100 m.p.h. in combination with sleet, snow, rain, and sand. Artificial sunlight equivalent to noonday desert sun can be simulated. Other features of the hangar include a jungle test room, a tropic-marine test room, and a desert test room; a stratochamber that can simulate pressures and temperatures at 80,000 ft.; and a jet-engine air unit that can supply up to 103,000 cu.ft. of air per min. for jet intake.

Guardian of "Happy Landings." *Bakelite Review*, Vol. 18, No. 4, January, 1947, pp. 8–10, illus.

Flexible pressure tapes and tubing made of Vinylite plastics are used in wind-tunnel testing at United Aircraft Corporation in measuring pressure distribution on aircraft structures. The tapes are $1^1/_8$ in. wide and consist of 20 longitudinal passages, each of which is only 0.028 in. in diameter. They are resistant to water, oils, greases, and many chemicals, are noninflammable, and possess high dielectric strength. Air pressures operating at the points of holes punctured in the tape are "conveyed" by the tape to recording instruments.

Nitrobenzene Dangers—Correspondence. Ernest F. Relf. *The Royal Aeronautical Society, Journal*, Vol. 51, No. 433, January, 1947, p. 69.

Because of the high toxicity of nitrobenzene, it should not be used to spray china-clay-coated models as a means of making boundary layer phenomena visible. Other substances are suggested which evaporate slowly and have a refractive index near to that of china clay crystals.

Wind Tunnel Solves Accurately and Safely Problems Important to Aircraft Design. Alan Pope. *Air Trails*, Vol. 27, No. 5, February, 1947, pp. 38, 39, 82–84, illus.

Aeronautical Research in Japan: Aerodynamics. T. F. C. Lawrence. *Australia, Council for Scientific and Industrial Research, Division of Aeronautics, Report No. A42*, June, 1946. 100 pp., illus. 18 references.

During a visit of 4 weeks in Japan, aeronautical research establishments, universities, factories, and laboratories were inspected and the personnel interrogated. The writer was impressed by the relatively large investment of money and man power in research, by comparison with Australian standards, and the generally meager results produced. The equipment in many cases was generally of better caliber than the personnel. There was evidence of poor management and negligent maintenance. A large proportion of the research workers were of inferior grade, although some of the older men could rank among the world's best. Failure of the armed forces to utilize the services of civilian scientists to the full extent was a potent reason for the inability of the Japanese to equal the progress of the Western nations. The organization, equipment, and research programs of the principal establishments are described.

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Books

All of the books reviewed and listed are in the I.A.S. Library and may be borrowed without charge, except for certain reference books. Application for loans should be made to The Paul Kollsman Lending Library, 2 East 64th Street, New York 21, N.Y.

The Official Pictorial History of the AAF. Historical Office of the Army Air Forces. New York, Duell, Sloan and Pearce, 1947. 213 pp., illus. $10.

This excellent official history is fittingly published on the thirty-fifth anniversary of the presentation of the first Military Aviator badge in 1912. It is appropriate that one of the recipients of that rating in that year, Gen. Henry H. Arnold, should have been the commanding general of the A.A.F. who directed that such a history be prepared. The A.A.F. grew up in less than 40 years. Much of its history was made by men still on active duty, who have battled against odds in both war and peace. The making of an official history could only profit by having such authorities available.

The book begins with the balloons of the Civil and Spanish-American Wars, aerial observers of their day. The modern history of the A.A.F. began with the establishment of the Aeronautical Division in the Signal Corps in 1907. Two years later the Wright Brothers' airplane successfully filled the Signal Corps' specification for an airplane capable of carrying two men at 40 m.p.h. The growth from that point can be measured at a given point easily in this book. The photographs are well selected and clear, and many of them are striking. The captions are good and the text is excellent. There are plenty of action pictures of both World Wars and of the period of flights, races, and records between wars. But the record is not only one of combat flying and spectacular records. The story of A.A.F. training, maintenance, and research, and of industrial and engineering "know how" must be woven into the piece, and it will be found there.

The book ends with a pictorial presentation of the development of military trainers, observation types, fighters, bombers, attack planes, transports, rotary wing types and gliders, and a section on the highlights of engine development.

The work of Major John T. McCoy, Jr., in the selection of photographs, book design, and paintings, including his own, and of Lt. Col. Bayrd Still in the editing of the text, is of the first order. Royalties from the sale of the book have been assigned to the Air Forces Aid Society. Orders should be placed with Department TF of the publisher, at 270 Madison Avenue, New York.

Supersonic Flow and Shock Waves, A Manual on the Mathematical Theory of Non-Linear Wave Motion. Prepared for the Applied Mathematics Panel, National Defense Research Committee, by the Applied Mathematics Group, New York University (AMP Report 38.2R). New York, New York University, Applied Mathematics Group, August, 1944. 282 pp., diagrs. Reproduced from typewritten copy. Declassified.

In his preface, Dr. Richard Courant states that in work with Dr. K. O. Friedrichs on practical contributions to problems of gas flow, a thorough understanding of the theoretic background was found indispensable. The present manual is an effort to condense their efforts in this direction. It developed from work on the theory of explosions and gas dynamics and is not claimed to be a balanced presentation. The merits of all recent contributors to the field could not be appraised, and certain subjects, such as phenomena in liquids as compared with those in gases, or the flow of compressible fluids around obstacles, were omitted or hardly touched.

Following a presentation of classical facts underlying any mathematical treatment of compressible flow, a theory is developed of the type of partial differential equations occurring in treatable problems of compressible flow, with emphasis on waves representing motion in domains adjacent to domains of constant state.

An extensive analysis follows of motion in one dimension, dealing with basic types of continuous motion, then an analysis of discontinuous motion or shock waves. Brief appendixes to this chapter deal with the theory of detonation waves, wave propagation in elastic-plastic solids under impact loading, and wave motion in open water channels. The case of steady two-dimensional flow is next discussed, including treatment of shock reflection. The final chapter concerns flow in nozzles and jets, and flow against obstacles such as projectiles, with an integrated summary of some work by Taylor and Busemann. The problem of spherical waves, or blast waves, is discussed briefly. A bibliography of 66 titles is included, which contains annotations and refers to more comprehensive bibliographies.

Aerodynamik der Luftschraube (Aerodynamics of Propellers). Fritz Weinig. (Berlin, 1940.) Ann Arbor, Mich., J. W. Edwards, 1945. 484 pp., illus. $9.75.

The author states that this work does not include the construction and stress analysis of propellers, and that certain general aspects of the propeller as affecting the mechanics of flight and general principles of airflow affecting the propeller are likewise omitted since they may be found in less specialized books. The book consists of four parts dealing with general considerations, experiments on propeller elements, performance of the complete propeller, and the propeller and airplane operating together. The first part deals with the geometry of propellers, including blade shapes, geometric properties of profiles, pitch and pitch angle and their distribution over the blade, moments of inertia, and propeller measurements. Experimental work and its evaluation are next taken up in relation to physical quantities for the study of propellers, airplanes, air, the influence of viscosity and compressibility, strength, and propeller efficiency. The second part deals with experiments on propeller elements and here the elementary propeller is given thorough treatment. Topics treated include the relation between efficiency and performance, relation between pitch, blade-width ratio and performance, propeller action in a diffuser, and the action of propellers in yaw.

In the third section, on the complete propeller, the theory of propellers of an infinite number of blades is

taken up with particular reference to friction, followed by the theory of propellers with a finite number of blades, and by a discussion of the calculation of propellers. In the fourth section, the propeller is considered according to various forces caused by motions of the airplane. This section includes also a discussion of ducted fans. The discussion ends with the influence of the slipstream on wings, fuselage, and air frame.

Two bibliographies are appended, one in the form of a table of 126 research reports and the values for various propellers found by their authors. The second bibliography lists 296 references on various aspects of propeller theory and research. This book is a major contribution to the knowledge of the aerodynamics of propellers, bringing a great deal of scattered information into one specialized source not duplicated elsewhere.

The Social Effects of Aviation. William F. Ogburn. Boston, Houghton Mifflin Co., 1946. 755 pp., illus. $5.00.

The first 82 pages of this work by a prominent sociologist constitute an explanation of the author's technique in making his predictions and forecasts, together with a short outline of the beginnings of aviation, with emphasis on those innovations which had far-reaching effects. Believing that foresight will help to mitigate the impact of the airplane on society, the author of *Technological Trends and National Policy* and *You and Machines* has compiled an exhaustive review of recent developments, present conditions, and future possibilities.

A reading of the book gives the impression that the author began with an all-inclusive outline of civilization and fitted into it any use or influence of the airplane that might have the remotest connection. Many of the conclusions drawn seem obvious; as for example, those who own machines will probably do a great deal of flying on week-ends, and musical artists can easily be exchanged, through aviation, between the United States and South America. The effects of aviation on the birth rate, religion, the family newspapers, public administration, leisure, and the arts are pointed out. Certain sections of the work will no doubt be of considerable value, mainly for the statistics, tables, and charts that have been assembled on such subjects as passenger travel, air cargo, landing places, private flying, and railroads. There are also useful bibliographic footnotes and a separate bibliography at the end of the volume. The value of this work seems to lie not in its analysis but rather in its assembling of numerous minor facts hitherto scattered.

Science and Life in the World. Vol. I. Science and Civilization; The Future of Atomic Energy. Vol. II. Transportation—A Measurement of Civilization; Light, Life, and Man. Vol. III. A Challenge to the World. The George Westinghouse Centennial Forum, May 16, 17, and 18, 1946; Sponsored by the Westinghouse Educational Foundation, Pittsburgh. New York, Whittlesey House, McGraw-Hill Book Co., Inc., 1946. Vol. 1, 152 pp., Vol. 2, 236 pp., Vol. 3, 198 pp. $7.50 per set.

A collection of the addresses delivered by leading scientists and educators at the George Westinghouse Centennial Forum. Their theme is the summary of the knowledge gained in recent years and its implications for present and future generations. Of special interest is "Aviation Phase" by Edward Warner, which reviews the latest developments in air transport, present domestic and international problems, and future possibilities. Volume one in the section "The Future of Atomic Energy" includes "A Future for Atomic Weapons" by Dr. J. Robert Oppenheimer and "Atomic Energy for Power" by Dr. Enrico Fermi. Significant remarks on airports are included in Harland Bartholomew's address in Volume two, titled "Transportation Planning in Urban Areas."

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Personnel Opportunities

This section is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Research Engineers and Physicists—Engineers, physicists, chemists, and mathematicians with research experience in problems related to aeronautics are needed by the National Advisory Committee for Aeronautics. Salaries for various positions requiring research experience range from $3,397 to $9,975 per year, depending on the type and level of work. Entrance positions for college graduates pay $2,644 per year. Areas of research include the following: aerodynamics, hydrodynamics, structures, materials, thermodynamics, compression and turbines, fuels and combustion, lubrication, mathematics, optics, electronics, radar, telemetering, servomechanisms, and other fields. Applications for positions or requests for further information should be addressed to the personnel officer at one of the following laboratories: Langley Memorial Aeronautical Laboratory, Hampton, Va.; Ames Aeronautical Laboratory, Moffett Field, Calif.; Aircraft Engine Research Laboratory, Cleveland.

Aircraft Equipment and Accessory Engineer—Excellent opportunity for graduate A.E., M.E. or E.E. with at least 4 year's practical experience as application engineer on electromechanical actuators, electric motors, and automatic control for aircraft. Reply to Lear, Incorporated, 110 Ionia Ave., N.W., Grand Rapids 2, Mich.

Electronic Engineer-Pilot—A position is open for a highly qualified electronic engineer who is also an expert multiengined pilot. The work will consist primarily of flight research and test of aeronautical automatic controls of many descriptions. The engineer will be involved from the inception of an idea or device, through its development stages, in the planning and flying of the tests, to the final demonstration and sales stages. It is desirable that the applicant be skilled in instrument and airways procedures or is a former air-line, N.A.T.S., or A.T.C. pilot. Apply by letter, giving engineering and flight experience and starting salary expected, to Chief Flight Test Engineer, Minneapolis-Honeywell Regulator Company, 2753 Fourth Ave. S., Minneapolis.

Engineers—Young engineering graduates with up to 3 years' experience required for test activity and aerodynamic or thermodynamic analysis on extensive and continuing development programs on nonrotating aircraft power plants. Mechanical or aeronautical engineers preferred. Address reply to Continental Aviation and Engineering Corporation, Detroit 14.

Aerodynamicists—College graduates with sound theoretical training and at least 1 year of graduate study in compressible subsonic flow and supersonic flow to do research and test work in the Supersonic Wind Tunnel of the Ballistic Research Laboratories, Aberdeen Proving Ground, Md. This is one of the few operating supersonic wind tunnels in the country having a test section larger than 1 sq.ft. Remuneration in accordance with qualifications. Write, giving education and experience, to The Commanding General, Aberdeen Proving Ground, Md., Attention: Director, Ballistic Research Laboratories.

Aerodynamicists, Flight Test Engineers, Mechanical Engineers, Electronics Engineers, Physicist-Mathematician, Administrative Engineer—Competent to assume additional responsibility in an expanding engineering organization as staff and project engineers on new, diversified, challenging work in the development of complex aviation devices. Only those applicants possessing initiative and ability to think analytically are desired. Plant is located approximately 200 miles west of New York City. Wages paid are equal to, or above, locality average. For further details write to: Personnel Manager, Link Aviation Devices, Inc., Binghamton, N.Y.

Structural Designers—Experienced in sheet-metal aircraft structures for new helicopter design. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Layout Draftsmen—Five or more years' experience on aircraft layout and design. Rotary wing preferred. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Aerodynamicist and Vibration Specialist—Experienced in rotary wing field. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Translators—Part-time, N.Y. residents, to abstract and translate foreign language articles on aviation. Must be thoroughly familiar with aviation terms of at least one language. Submit language experience, background, etc., to Accurate Translation Service, 711 Woodward Building, Washington 5, D.C.

Assistant Designer—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must be capable of taking full responsibility for undercarriage design projects, and should have had some experience in design of hydraulic pumps, systems, and electro-hydraulic units. Knowledge of stress analysis and familiarity with both British and American engineering practices also desirable. This is a permanent position with good prospects. Starting salary $275 to $300 per month, depending on qualifications. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Senior Draftsman—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must have minimum of 3 years' experience in the more mechanical side of aircraft design work and, preferably, 1 year's design experience on undercarriage and hydraulics, variable-pitch propellers, fuel systems, or other similar accessories. Should be capable of detailing any undercarriage or hydraulic layout and of carrying out elementary stress analysis. Familiarity with both British and American engineering practices also desirable. This is a permanent position with attractive prospects. Starting salary proportional to qualifications offered. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Assistant or Associate Professor—To teach courses in aerodynamics and wind-tunnel and airplane design. Must have graduate work in aerodynamics. Prefer man with teaching and practical experience. Salary and position will depend upon qualifications. Applicants should submit detailed record of education and experience. Address reply to Aeronautical Engineering Department, University of Kansas, Lawrence, Kan.

Aerodynamicists and Aeronautical Engineers—Positions available for highly qualified technical personnel with good theoretical or experimental background to engage in development and test work in stability, control, high-speed, and supersonic aerodynamics. Projects include new designs of piloted and pilotless aircraft, new wind tunnels and associated equipment, and advanced testing techniques. Salary in accordance with qualifications and Civil Service regulations. In reply please give brief summary of personal qualifications, education and experience. Address: Director, David Taylor Model Basin, Washington 7, D.C.

Layout Draftsmen—College graduates preferred, with aeronautical or mechanical engineering degrees. Must have 3 to 5 years' experience in aircraft industry as layout draftsmen working on structures, stress analysis, and design. Plant located just outside Washington, D.C. Address inquiries to Engineering and Research Corporation, Riverdale, Md.

Engineers and Physicists—The Cleveland Laboratory of the National Advisory Committee for Aeronautics has openings for engineers and physicists to work in fundamental research applicable to aircraft propulsive systems. Research is in progress on engine performance, fuels, thermodynamics, compressors, turbines, and materials. Applications of the principles of fluid mechanics are being investigated in the speed ranges covered by subsonic, transonic, and supersonic flow rates. There are openings for professional men ranging from a starting rate of $2,644.80 per annum for men just out of college to $8,179.50 per annum for men with qualifying experience in their respective fields. Apply to National Advisory Committee for Aeronautics, Cleveland Airport, Cleveland, Ohio; Attention, Mr. John D. Tousignant.

Chief Aerodynamicist—Services of highly qualified aerodynamicist required to act as Chief Aerodynamicist. Applicants must be graduate engineers from recognized universities. Experience on personal aircraft desirable. Applicants should write, giving complete details of education, experience, and salary expected, as well as availability, to Fleet Manufacturing and Aircraft Limited, Fort Erie, Ontario, Canada.

Aerodynamicists—One or two positions open for experimental and theoretical research in supersonic aerodynamics in Navy Ordnance development program. Preference given to applicants with experience in supersonic field but will consider those with good background of fundamentals and subsonic work who wish to acquire experience in supersonics. Salary dependent on education and experience. Address: Dr. M. J. Thompson, Associate Director, Defense Research Laboratory, The University of Texas, Austin 12, Tex.

Physicist or Research Engineer—To do basic research and development work in applied optics related to supersonic airflow visualization. Work includes application of spark and schlieren photography and interferometry to supersonic wind tunnel test program. Salary dependent on education and experience. Address: Dr. M. J. Thompson, Associate Director, Defense Research Laboratory, The University of Texas, Austin 12, Tex.

Research Engineer—Responsible position open with small corporation engaged in development engineering on aircraft instrumentation and con-

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trol systems. **Background of mechanical engineering or applied physics required.** Address inquiries to Flight Research & Engineering Corp., P.O. Box 1-F, Richmond, Va.

679. Professor of Aeronautical Engineering—To take charge of work in established department of aeronautical engineering at a large engineering college. A man with graduate degree, teaching and industrial experience preferred. Rank and salary dependent upon educational background and experience.

672. Professor or Associate Professor—Aeronautics department of engineering school desires services of professor capable of teaching undergraduate and graduate courses in aircraft propulsion. Must have good academic training and teaching experience. Will have supervision of entire aircraft power-plant course program. Fully permanent position. Detailed description desired of education, teaching, and industrial experience. Salary and rank dependent upon qualifications.

671. Instructor or Assistant Professor—Sought by Aeronautical Engineering Department of Southwestern university. Should have master's degree and be able to teach in fields of aerodynamics and fluid mechanics, structures, and power plants and be capable of specializing in one of these.

670. Research and Aerodynamics Engineers—Long-term helicopter development program for Army Air Forces requires additional experienced and capable engineers. Exceptional working conditions and opportunities. Work involves aerodynamics, vibration, and flutter analyses on advanced designs. Substantial experience in aerodynamics or vibration work essential. East Coast company.

651. Aeronautical Administrative Engineer—Experienced in handling Navy Contract procedures and in designing for production. All replies will be held confidential. East Coast company.

643. Professor of Aeronautical Engineering—To take charge of this work in a well-established department where specialization is largely in aircraft propulsion and aerodynamics. Large graduate enrollment, good industrial contacts, and opportunities for consulting and research work. Salary attractive.

634. Chief Engineer—Leading aircraft accessory firm making mechanical devices for aircraft. Located in a desirable Midwest city. Excellent opportunity for the proper man. Should be experienced in machine design, electrical design, small mechanisms, and possibly small rotating machinery. Must be experienced in handling people, supervising design, making engineering decisions for production, and supervising large number of projects. Please send complete information in first letter on entire background, including salary requirements and recent salaries. Our employees know of this opening and therefore applicants will not be embarrassed by writing to their own employer.

629. Assistant Professor—To conduct classes in airplane detail design and stress analysis in large engineering college. Must have aeronautical engineering degree and industrial experience. Advanced degree preferred but not essential. Immediate appointment. In replying, please submit brief record of education and experience.

627. Aeronautical Engineer—Civil Service position open immediately in Washington, D.C., for aircraft engineer with several years of progressive experience in structural design. Good opportunity for permanent appointment for engi-

neer having proper qualifications. Duties involve responsibility for accurate investigations of special design problems and authoritative review and evaluation of major structural design features of new military aircraft to ensure compliance with Navy requirements and good engineering practice. Salary $5,905 per year. In applying give brief sketch of personal qualifications, education, and experience.

626. **Propeller Project Engineer**—Immediate permanent opening for project engineer with design experience in controllable-pitch propellers from 65 to 200 hp. Good testing facilities available and excellent opportunity for advancement with established Mid-West manufacturer. Reply stating full particulars of past experience, salary required, and other useful information.

616. **Associate or Full Professor**—A leading Midwestern university which is developing an extensive graduate instruction and research program in the fields of high velocity aerodynamics and jet propulsion needs an additional permanent staff member. Teaching will consist of one-third to one-half of load, balance on research. Rank will be Associate or Full Professor. Salary attractive; advanced degree required plus practical experience.

490. **Assistant or Associate Professor**—Sought by Aeronautics Department of Engineering College to teach undergraduate and graduate courses in aerodynamics, aircraft structures, or aircraft propulsion. Must have good academic training and teaching experience; constructive interest in aeronautical research and development, preferably industrial or laboratory experience in this field. Starting salary range: $4,000 to $6,000 depending upon qualifications.

AVAILABLE

695. **Administrative Engineer**—Age 40; 6 years in aircraft engineering department, from design engineer to managing the department of approximately 2,000 people. Past year personnel manager of newly organized aircraft maintenance base. Previous experience as an instructor in aeronautical subjects and draftsman. Desires permanent position, preferably in aircraft, involving engineering and personnel administration. Location open.

694. **Management**—Age 43, married, A.B. degree and B.S. in Aeronautical Engineering, plus legal training and experience. Author of seven outstanding textbooks on technical subjects. Biography in *Who's Who in America*. Member I.A.S. and Associate Member American Institute of Electrical Engineers. Last 6 years spent organizing and managing aeronautical training for engineers, pilots, and mechanics in advanced types of aircraft. Desires permanent position as organizer and manager of a well-financed college or school wishing to develop strong courses in aviation business administration, jet and gas turbine propulsion, or electronics. Prefers West Coast.

693. **Development Engineer**—Graduate engineer, with 8 years' experience in hydraulics, landing gear and mechanical design, seeks position with small company where the opportunity exists to expand along with the company.

692. **Mechanical Engineer**—Graduate; age 30; 4½ of 6 years' experience in development of mechanical components of helicopter aircraft. Interested in development work. Location: (1) New York; (2) San Francisco; (3) Seattle.

691. **Aeronautical Engineer**—B.Ae.E., 1942. Age 25, married. Two years' experience in design evaluation of regular and experimental aircraft. Two years' experience in aircraft flight testing and aircraft maintenance. One year's experience in supersonic research leading to the design of guided missiles. At present engaged as a research technician in supersonics. Desires administrative position as a project engineer in the research and development of supersonic aircraft. Familiar with Government contracts and procedures.

690. **Administrator-Industrial Management Engineer**—Representative completing 6 years in Naval Aviation as administrator of fixed price and cost-plus fixed fee airplane contracts from inception to fly-away at several large plants and the Bureau of Aeronautics. Ten years' civilian aircraft experience covering production, engineering, and quality control. Good engineering training secured at recognized technical institute and university.

689. **Engineer**—Five and one-half years' experience as layout draftsman on aircraft construction; location in Eastern States preferred.

688. **Engineer**—B.A.E., N.Y.U., major in air transport and meteorology. Two years' experience leading aircraft instrument and accessory manufacturer as designer, junior administrative engineer. Served in U.S. Navy as officer engineer in design and development of autopilots and radio-controlled aircraft and structural test models; 1 year's experience in this field including considerable flight-test work. Six months' experience with Navy as production control officer in aircraft plant. Desires work in East Coast area in any of the above fields.

687. **Professor or Aeronautical Engineer**—Ph.D. in Mathematics and Physics. Author of a number of published articles in aerodynamics and mathematics. Ten years' teaching experience in graduate and undergraduate engineering mathematics; over 7 years' general aircraft engineering experience, including positions as project aerodynamicist and engineering specialist on Navy and Army aircraft and guided missiles. Available for responsible position immediately either with aeronautical college or with aircraft industry.

686. **Sales Engineer and Aeronautical Marketing Consultant**—Exceptional aeronautical background and history. Entree to every phase of aircraft manufacture and operation. Internationally known and respected. Has excellent contacts, particularly on the Pacific Coast. Has designed and patented several successful accessories. Has been in the aircraft field for over 30 years.

685. **Aeronautical Engineer**—B.Ae.E., Rensselaer Polytechnic Institute with honors, full member Sigma Xi, Tau Beta Pi; now completing master's work at M.I.T. with major in vibrations and stress analysis. Energetic, intelligent, and learns quickly. Has ability to assume and desires responsibility. Desires employment in vibration research or flight-test analysis with concern on East Coast or opportunity to develop courses in vibrations at small engineering college. Plans to extend education in law and engineering administration. Résumé on request.

684. **Teacher**—College teacher desires position teaching aeronautical engineering at recognized college or university. Possesses B.A.E. degree, magna cum laude. Doing graduate work at present on parttime basis. Three years of progressively responsible industrial experience including analysis and design of tubular and stressed-skin structures and of the mechanical elements of civilian and military aircraft, particularly in the rotary wing field. Also some experience in theoretical aerodynamics. Over 1 year's experience as instructor of mechanical engineering at accredited college. Qualified to teach courses in aerodynamics, fluid mechanics, advanced strength of materials, airplane design, structures and stress analysis, and rotary wing aircraft.

683. **Air Cargo Transport Engineer and Administrator**—Available on short notice, internationally known air transportation engineer, specializing in air cargo. Just completed setting up largest all-cargo operation in Western hemisphere, in South America. Capable of making complete survey, procuring equipment and personnel, and setting up operating organization. Would be interested in acting as consultant for major railroad anticipating aircraft activity or any other organization interested in air cargo. Thirty years' experience in the aircraft operating field. Has lived and operated in Europe and South America.

682. **Aeronautical or Administrative Engineer**—Age 33, married. Ten years' aircraft engineering experience, including drafting of specifications, structural design, aerodynamics, and 3 years' service in the Engineering Division at Wright Field as an A.A.F. officer. Familiar with current A.A.F., Bureau of Aeronautics, British, and C.A.A. structural and design requirements. Desires position about June 1.

681. **Physicist-Mathematician**—Age 35. B.S. in E.E., M.A. in Mathematical Physics, B.Sc. (Oxon.) in Astrophysics. Presently Associate Professor Aerological Engineering. Four years' experience scientific book publishing (McGraw-Hill). Five and one-half years' Navy. Desires position Northeastern United States in research and/or teaching with growing responsibilities in administration.

680. **Aeronautical Engineer**—B.S. degree in Aeronautical Engineering, Aeronautical University, Chicago. Five years' experience in design and research with leading aircraft manufacturer, including work in stress analysis, aerodynamics, and jet propulsion. Holds private pilot's license and has had some aircraft mechanic experience. Prefers Southern California.

678. **Aeronautical Engineer**—With administrative experience desires position as personal assistant to executive in air line, aircraft manufacturing or related activity who should be relieved of concern over details—correspondence, reports, speeches, department liaison. Aero engineering degree, Harvard Business School. Six years' over-ocean air-line experience in maintenance and engineering, in which presently employed. Ex-Naval officer, free to travel. Has smattering of Spanish. Age 29. Interview desired.

677. **Aeronautical Engineer**—Technical degree received from well-known and approved cooperative engineering college of a midwestern university. Three and one-quarter years' complete stress analysis experience with leading personal plane manufacturer. Some liaison and service engineering experience. Desires position with personal plane or helicopter manufacturer or consulting engineer as a structures, service, or liaison engineer. Will consider position as aerodynamicist or sales engineer of a reliable company with a temporary salary sacrifice if well-rounded experience will be gained. Complete information will be given on request.

676. **Aeronautical Engineer**—B.Ae.E. More than 5 years' experience in experimental aerodynamics and flight testing. Present position is that of project engineer on high-speed developments. Desires position in Northern New Jersey or New York City which involves work in aerodynamics, design, flight testing, or wind-tunnel testing.

675. **Technical Translator**—Graduate mechanical and aeronautical engineer, German born, U.S.-educated, thoroughly bilingually familiar with engineering terminology, will translate German technical documents on a contract basis.

674. **Aeronautical Engineer**—Aerodynamicist, B.Ae.E., age 22, single. Has over 2 years' experience in wind tunnel work, air loads, performance, stability, and control. Will receive M.Ae.E. during present school year. Good background in theoretical aerodynamics, stress analysis, and jet propulsion. Interested in teaching. Must remain in New York City vicinity until July 1. Available immediately.

673. **Teacher**—Graduate of the Massachusetts Institute of Technology in aeronautical engineering desires a teaching or administrative position with a foreign or domestic college or university. Qualified to teach aerodynamics, airplane design, wind-tunnel techniques, modern flight-testing methods, air-transport problems, and related fundamental subjects. Holds C.A.A. single- and multiengined commercial pilot's license, with instrument and instructor ratings. Prefers position with opportunity for combining academic work with flight testing, flight demonstration, and/or flight instruction. Has had administrative, practical, and teaching experience

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in the aviation field. Will gladly furnish complete credentials, with references, upon request.

669. Aerodynamics Engineer—Chief aerodynamics engineer with prominent aircraft company. Advanced degree in mathematics and physics. Publications in dynamics and thermodynamics. Experience in aircraft heating and deicing. Desires position in metropolitan area with progressive concern or recognized university.

668. Administrative or Executive Engineer—Twenty years' well-rounded experience in all phases of organization, systematizing, design, engineering, production, and helicopter. Has experience in the automotive, aircraft-engine, and aircraft industries. Formerly experimental engineer, assistant engineer, factory manager, and general manager. Will definitely consider position in other than aircraft industry.

667. Aeronautical Engineer—B.S. Degree in Mechanical and Aeronautical Engineering. Taking graduate studies majoring in aeronautics. Two years' experience in drafting and aerodynamics in the aircraft industry, doing layout, major detailing, casting and forging drawing. Interested in aerodynamics or stress-analysis positions. Will accept mechanical or aeronautical engineering position in the Far East, especially in the Philippines.

666. Sales and Service Engineer—B.Ae., N.Y.U., 1941; married, age 28. Four and one-half years' A.A.F. Engineering Officer (Major). Varied technical and administrative assignments in connection with modification, overhaul, and repair of all types of aircraft and associated equipment. One year own manufacturing business. Few months air line. Completing training for Commercial Pilot Certificate. Particularly interested in sales and service or employment with overhaul and/or modification agency.

665. Training Supervisor—Twelve years of practical aeronautical and teaching experience, ranging from instructor to training supervisor at a U.S. Naval aircraft shore establishment. Background includes the training fields of private trade school, public school, air line, and Government plants. Capable of planning, administering, coordinating, teaching, and testing school, shop, and supervisory improvement courses. Experience has covered mechanical training on the job, apprenticeship training, supervisory improvement training and testing, and veterans' training.

664. Aeronautical Engineer—B.Ae.E., age 29, married, veteran of World War II. Four years as a Naval Aviator. Two thousand hours' flight experience in single- and multiengined land and sea aircraft. Posseases valid commercial pilot's license. Experience as a project engineer, design draftsman, and stress analyst. Working knowledge of all phases of aviation. Desires position as a flight test engineer. Will consider positions anywhere in the continental limits of the United States.

663. Engineer—Heating, ventilating, and exhaust systems engineer; B.S. in Ae.E. Age 29, married. Four and one-half years' experience in the design, maintenance, and overhaul of aircraft exhaust, heating, and ventilating systems. Completely familiar with all types of aircraft and ground heaters, heat exchangers, anti-icing and deicing systems and ventilating systems. Experienced in problems relating to aircraft-engine exhaust systems, such as collector rings, short stacks, flame dampeners, silencers, and carburetor heater shrouds. Has a working knowledge of turbosupercharger and induction systems. Exceptional executive and supervisory experience. Desires position as sales or field service engineer. Other engineering positions will be considered.

662. Production or Factory Management—B.S.E. (Aero. Eng.); top quarter, Big Ten University class. Six months' prewar experience in production control with leading parts manufacturer. Three years as A.A.F. engineering officer in charge of aircraft overhaul subdepot, supervising 350 civilian employees, machine shop, sheet metal, welding, woodmill, etc. One year postwar as aircraft structures engineer. Desires responsible position in production or factory management

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with progressive-minded manufacturer of mechanical products. Keenly interested in production control, production planning, and factory management and will consider opportunities in any related position. Mid-West preferred.

661. Research Engineer—Age 29. B.S. in M.E., University of Pennsylvania, 1940. Experienced analyst in thermodynamics, heat transfer, general fluid mechanics, and aerodynamics. Present employer well satisfied, but applicant wants nonmilitary research work. Six and one-half years with large aircraft manufacturer, past year and one-half on supersonic studies, including setting up Schlieren optical system and developing method of analysis for flow of compressible fluids.

660. Engineer-Pilot—M.E.; several years' experience many military and commercial types, land, sea, and helicopter; commercial and instrument ratings; 4 years' test and research with reputable organizations. Good knowledge of operational problems; well acquainted with current electronics equipment and its limitations. Desires change. Interested in pilot-engineering-administrative position with concern having well-backed program.

659. Aeronautical Engineer—B.S.A.E., age 30. Eight years' aircraft engineering, design, and fabrication experience including 2 years of stress analysis and testing; 2 years of production engineering and liaison work; 4 years as design group leader on surfaces, controls, and power plant installation; assistant project engineer. Present position design engineer, general. Familiar with Army, Navy, and C.A.A. requirements. Some experience on guided missiles. Presently taking evening graduate work in mathematics and engineering. Interested in design work. Available on 30 days notice. Location open.

658. Administrative-Executive-Field Service—Desires to join group with sound research and modest production program. Twenty-one years' experience in the industry in almost every phase; now staff member in responsible position with large engine firm. Holds commercial pilot's license with instrument and instructor ratings, single- and multiengined, A and E license. Prefers to affiliate with group that can use several thousand hours' flying experience plus sales and executive ability.

656. Management Executive—B.S. in M.E. Over 20 years' experience in aviation, including engineering, production, quality control, materials, contracts, labor problems, costs, contract termination, and property disposal. Five years' research, N.A.C.A., hydrodynamics, and aerodynamics. One year on flight performance data analysis. A and E mechanic, private pilot. During war represented the Bureau of Aeronautics in plants of major aircraft manufacturers, heading staffs up to 160 engineering, clerical, and shop personnel. Long experience in dealing with Government agencies. Desires responsible position with an organization needing a versatile, well-informed executive.

655. Engineer or Executive—Twenty-four years' experience in tool, production, and design engineering; 8 years in aircraft. Positions filled include project engineer, chief tool designer, chief production engineer, and chief engineer. Thoroughly capable of handling either design, production, or tooling and methods. Willing to accept lesser position if opportunity for advancement is evident.

654. Administrator-Engineer—Twenty years in aviation engine and airplane manufacturing, including 3 years as project officer on transport aircraft design in Bureau of Aeronautics. Experience includes positions in engineering, financial, and administrative divisions. Capable, versatile, dependable. Desires connection as military liaison, manufacturer's representative, or executive assistant in New York area.

653. Aeronautical Engineer—Age 25, married. B.S. in Ae.E.; 2 years' experience as stress analyst in large aircraft plant. At present, graduate student at M.I.T. completing studies toward S.M. in Ae.E. in June. Desires work about July 1 in flutter or high-speed aerodynamics.

652. Aeronautical Engineer and Aircraft Maintenance Engineer—B.S. in Ae.E. Age 28, married. Five years' experience with A.A.F. as Aircraft Maintenance Officer with rank of Major. Maintenance experience on single-engined, twin-engined, and four-engined aircraft. Diversified experience in personnel management. Desires supervisory position wherein a high degree of responsibility must be held. Now holding responsible engineering position with leading air line.

649. Aeronautical Management or Administration—28 years old, married. B.S. in Mechanical Engineering from Purdue in 1940, with major in industrial engineering and aeronautical engineering courses. Four years' experience with large aircraft-engine manufacturer as an engineering trainee and as a field service representative and 2 years as a power-plant engineer for a transcontinental air line. Desires permanent position in management or administration of an aeronautical concern with an opportunity for advancement.

648. Field or Sales Engineer—Five years' experience in foreign and domestic field in installation and sales engineering for major aircraft instrument company. Experience includes work with latest-type gyros and automatic flight control and automatic approach control equipment. Three years' contact with aircraft concerns in Southern California. Desires position on West Coast.

646. Administrative—Desires responsible administrative connection, and will consider investment, in new or expanding aviation enterprise. Has extensive knowledge and resourcefulness resulting from training in aviation specialties, business administration, and manufacturing, plus active association with aviation during past 10 years and prior experience in business organization, office management, accounting, manufacturing, and sales. Capable of handling personnel and developing a well-rounded organization.

645. Associate Professor of Aeronautical Engineering—Doctor of Aeronautical Engineering in a large Mid-Western university would like to change his position for a similar one. At the present time gives structural courses. Possesses experience in wind-tunnel operation and a thorough knowledge of aerodynamics.

644. Foreign Sales Engineer—Internationally known aeronautical engineer and editor, 10 years of foreign experience, linguist, desires position as foreign sales manager, sales engineer, or European contact man for American aircraft or aircraft equipment manufacturer. Willing to locate in Europe. Has influential Governmental, commercial, and private contacts in various countries. Top references available. Age 40, personable, executive type.

641. Aeronautical Engineer—B.Ae.E., Rensselaer Polytechnic Institute, 1939. Age 31, married. Private pilot. Eight years' design and field engineering work including administrative and supervisory experience for major aircraft accessory manufacturer. Ground and flight test experience, both Army and postwar commercial planes. One year project engineer and market analyst for development of light-plane products. Well-established West and East Coast aircraft contacts. Desires administrative or sales engineering position in aircraft or allied industry. Prefers East or West Coast. No objection to traveling. Available immediately.

639. Stress Analyst—Ten years' varied experience as stress analyst. In charge of complete stress and static test data for several small companies. Chief of Structures for a well-known personal plane manufacturer. Experienced in all-wood, steel tubular, and all-metal aircraft. Desires position relating to structures and utilizing the maximum of experience. Midwest or Eastern location preferred.

638. Aeronautical Engineer—B.S. in M.E., 1934, New York University (Guggenheim School of Aeronautics). Eight years' general aircraft engineering experience, including positions as Project Engineer, Chief Aerodynamicist, and Acting Chief Engineer on Naval aircraft, helicopters, and amphibians. Available for responsible position immediately.

637. Mechanical and Aeronautical Engineer—B.S. in M.E., Aeronautical Engineering option, 1936. Will receive M.S. degree in M.E. during present school year. Two years' experience machine tool design. Three and one-half years' experience in aircraft propeller design and vibration research. Almost 1 year's experience in aircraft automatic landing electronic equipment research. Thirty-nine months' service in Army Air Forces Air Matériel Command's Engineering Division Laboratories as Project Officer with considerable supervisory responsibilities. Highest references. Desires position in engineering liaison, sales, or development in aircraft or mechanical equipment manufacturing.

636. Mechanical Engineer—Age 28. Interested in engineering sales. Three years' experience in steel industry as specification writer, field engineer, and maintenance foreman. Three years' experience in the aircraft industry as design layout draftsman and flight-test engineer. Employed at present by research and development engineering concern working on aircraft gas turbines.

633. Executive Assistant and Industrial Engineer—Age 38, single; 13 years' engineering experience including cost analysis, planning and scheduling production, sales forecasting, budgetary control, etc., as well as airport management. Can assist on product development and production of plastic structures and/or prefabricated houses. Also qualified to handle business relations with Government agencies. Separating from A.A.F. after 2 years overseas and 3 years' procurement and development engineering.

632. Aeronautical Engineer-Export—B.Ae.E., Rensselaer Polytechnic Institute. Ex-Naval Officer with 1 year's liaison engineering experience on high-speed research; 1 year's electronics training in the Navy; 1 year's practical work in aircraft production; 3 months' experience as buyer for export, plus publicity work. Graduate of European high school; has done atomic physics graduate work. Desires participation in export or establishment in an engineering product manufacturing company or airways in Southern Europe, South America, New York, or Los Angeles area.

631. Test Pilot—Graduate aeronautical engineer. Over 4,000 hours' single- and multiengined ratings. Instrument and instructor ratings. Radio license. Three years' test pilot for Navy. Experienced in making engineering reports. Prefers test flying work with engineering work anywhere in the United States.

618. Meteorologist-Engineer—Graduate meteorologist and engineer; B.S. Meteorology, New York University; B.S.M.E., Case School of Applied Science. Age 28. Served as commissioned meteorologist with A.A.F. in U.S. Served as operations and dispatch officer with A.T.C. overseas for 14 months. Three and one-half years in service. Position wanted with air line or other concern interested in air transportation. Interested primarily in flight operations or traffic promotion work. Holder F.C.C. radio permit and C.A.A. Tower Controller's Certificate. Will consider work in domestic or foreign fields.

588. Management or Administration—Twenty-seven years old, single, A.B. degree, University of Pennsylvania. Major in political administration, courses applicable to business administration. Courses in industrial engineering including industrial relations, business and government, organization and organizational structure. Aeronautical engineering courses in elementary aerodynamics, performance calculation, aircraft drafting and engineering. Two and one-half years in aircraft testing in present position. Desires permanent position on junior level in management or administration with opportunity for advancement. Philadelphia area.

HOW *ONE* VERSATILE METAL MEETS *FIVE* METAL REQUIREMENTS

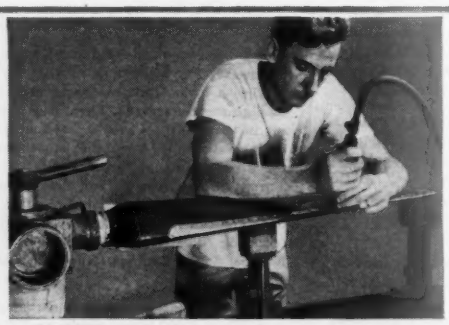
The excellent engineering design of the Aeromatic automatic pitch-change propeller is matched by careful selection of metal. In blade-tip and -edge construction, for example, one metal—MONEL*—meets the five following requirements.**

1. STRENGTH. The Aeromatic propeller needs Monel's high strength to lend support to thin blade tips and edges. Monel's high fatigue strength also eliminates danger of cracking because of flexure.

In the above illustration a small, punch-formed Monel tip-piece is about to be riveted in place.

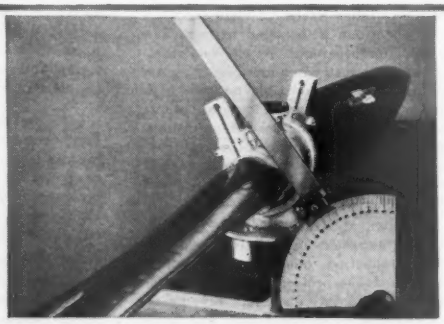
2. HARDNESS. Whirling at a speed of 1000 ft. per second, unprotected propeller-tip sections could easily be damaged by sand, twigs . . . even drops of water. Hard, tough Monel deflects these particles . . . without damage to the metal or the relatively soft wood of the blade.

Photo shows application of leading edge sheathing. Holes are drilled and countersunk to receive rivets and screws.

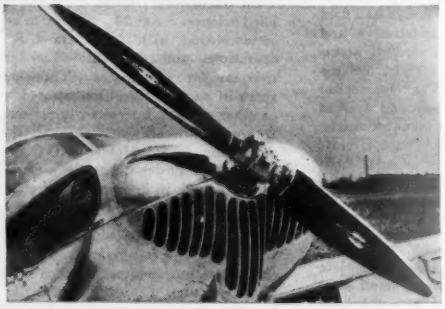


3. EASY FORMING. Monel sheathing is readily preformed to fit leading edges and blade tips. Tip caps have a relatively deep draw. Edge strips fit closely at all points.

In the above photo, tiny wrinkles, caused during riveting, are being ironed out with a pneumatic hammer. Monel had sufficient ductility to allow these wrinkles to "flow out" properly in the hammering process.



4. SMOOTH FINISH. Here a completed blade, fitted to the Aeromatic hub, is being position checked. Note smooth, flawless finish of Monel sheathing. This finish, necessary to maximum aerodynamic efficiency can be maintained indefinitely by repeated burnishing . . . without weakening the metal.



5. CORROSION RESISTANCE. Monel's ability to fight off corrosion was a fundamental reason why it was chosen for the Aeromatic propeller. Monel withstands the attacks of salt and fresh water, and high-octane fumes. It *cannot rust.*

Photo shows Aeromatic propeller on Globe "Swift," 125 HP 2-passenger light plane.

The photographs above illustrate only one of the applications in which Monel and the other Inco Nickel Alloys are serving under severe conditions of corrosion, high pressure, high temperature and incessant vibration.

Our engineering staff is ready to help you determine which Inco Nickel Alloy has the combination of properties best suited to your particular job. Write today, sending them a description of your metal problem.

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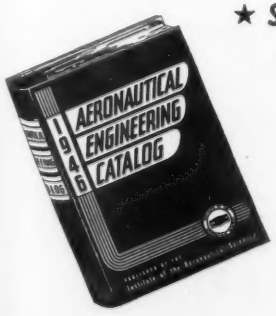

★ *Specifications and further information on the aircraft products of these companies will be found in the*

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The only publication of its kind devoted exclusively to the aircraft industry this CATALOG serves as a valuable buyers' and reference guide to sources and specifications on aircraft materials, parts, and accessories. It is distributed annually to Chief Engineers, Designers, Production Heads, and Purchasing Departments of all leading Aircraft, Aircraft Engine, Instrument, Accessory, and Aircraft Parts Manufacturers; Air Transport Companies; Army, Navy, and Governmental Agencies; Research Organizations; Engineering Libraries; etc.

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This new model, now in production for the new Lockheed Constellation, incorporates many advancements to provide greater power and reliability in airline operation.

The increase in horsepower to 2500 makes the CYCLONE 18BD the most powerful 18 cylinder engine in the world. Among its many new design features are a *Cylinjector system*—the direct injection of fuel into each cylinder; *low tension ignition* for improved performance at altitude; *piston oil jets* for prolonged piston and ring life; *forged aluminum cylinder heads with differential finning* for greater cylinder strength and improved cooling; and *automatic spark advance* for cruising economy.

Although it is a direct descendant of the earlier CYCLONE 18 engines that have broken 98 world records for long distance, altitude with load, and speed with load, the CYCLONE 18BD is the newest model specifically engineered by Wright for commercial transports.

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